THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. XC. No. 2198.] LONDON, JUNE 27, 1905. [57TH YEAR. PRICE 6d.

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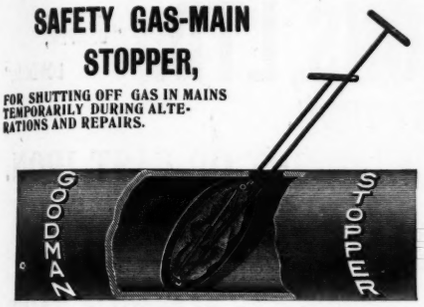

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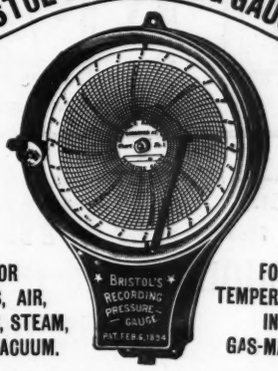

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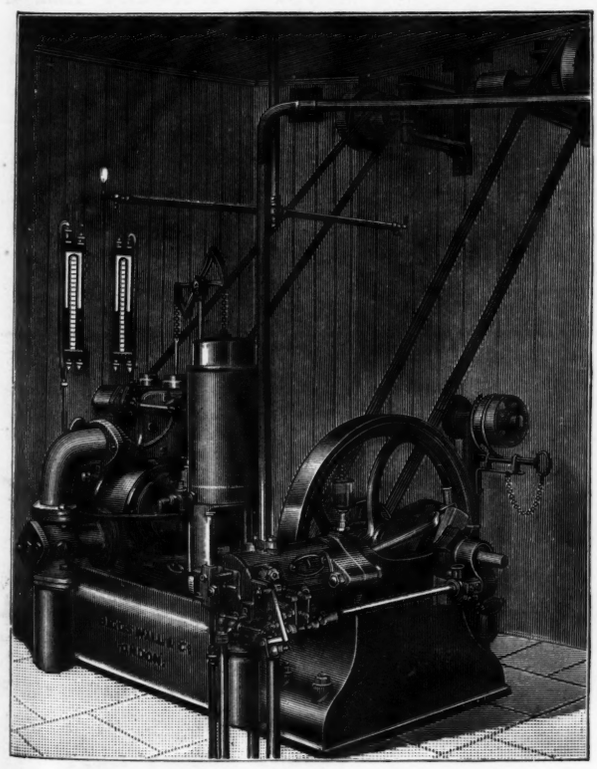

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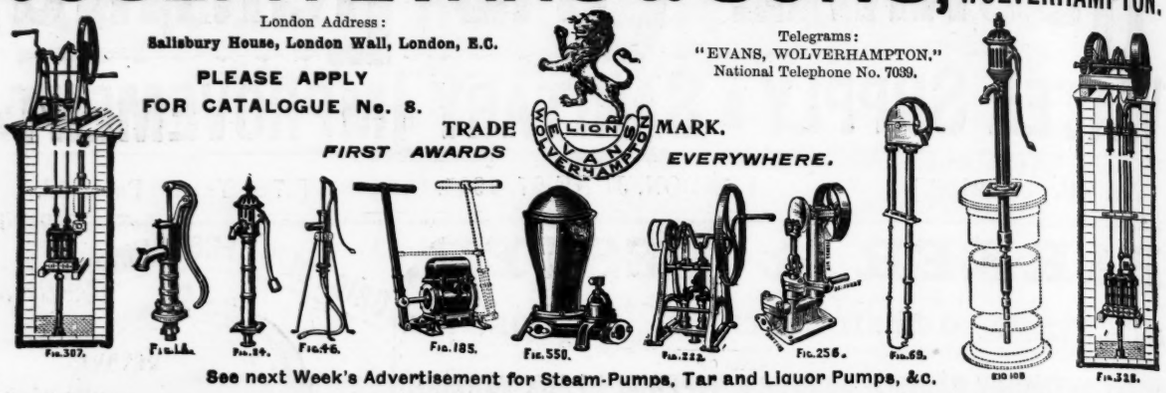

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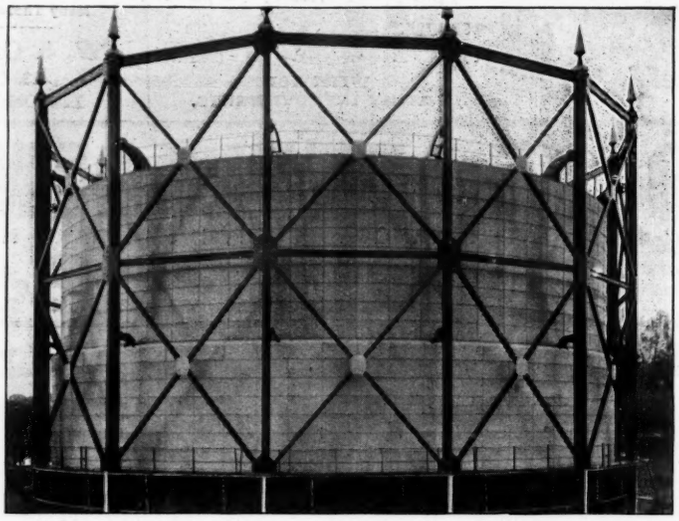

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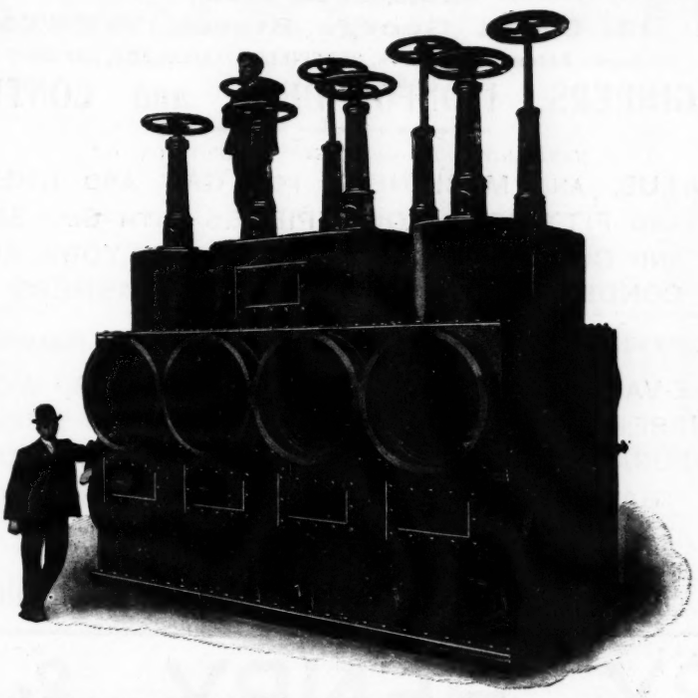

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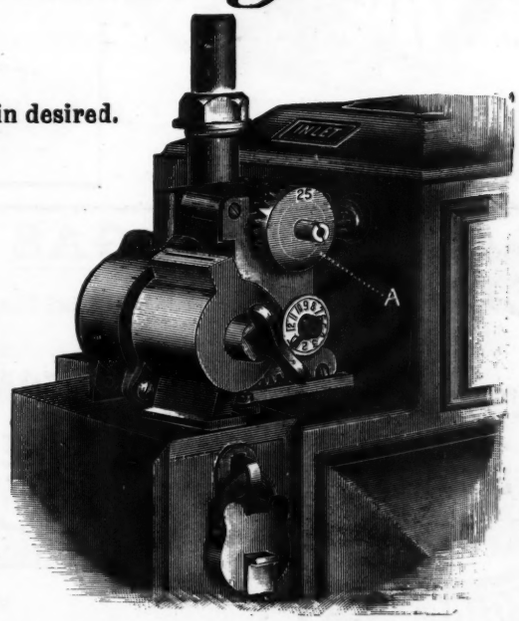

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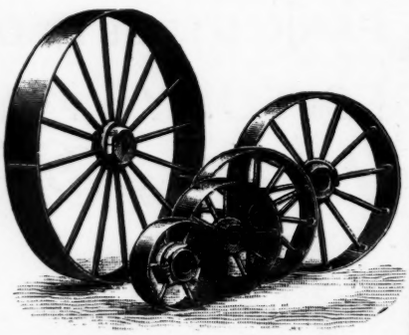

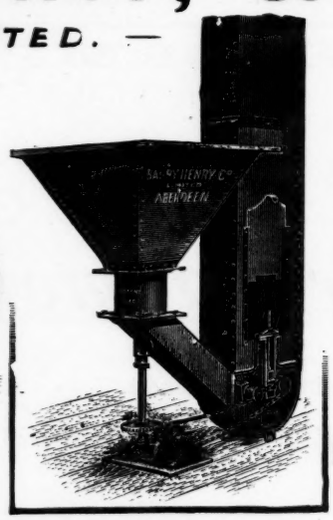

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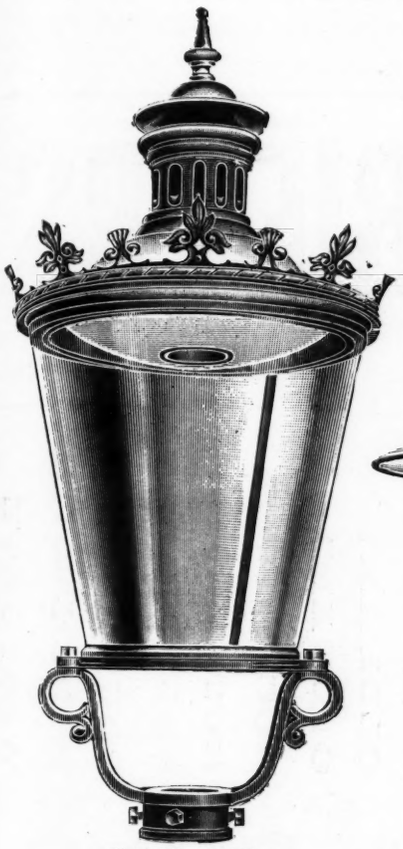
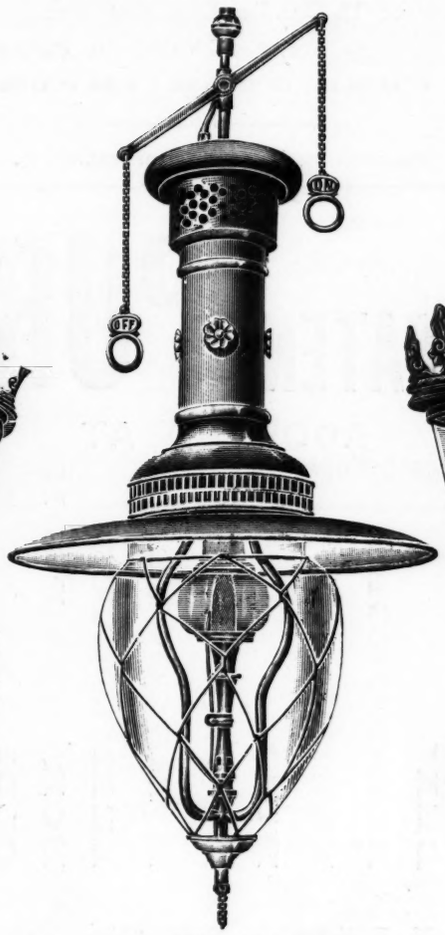


Fig. 35. 100 c.p.



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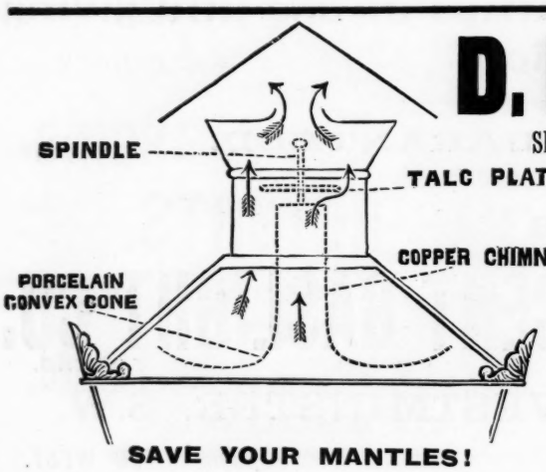

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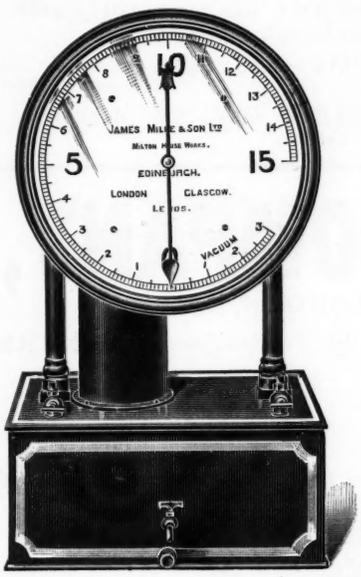

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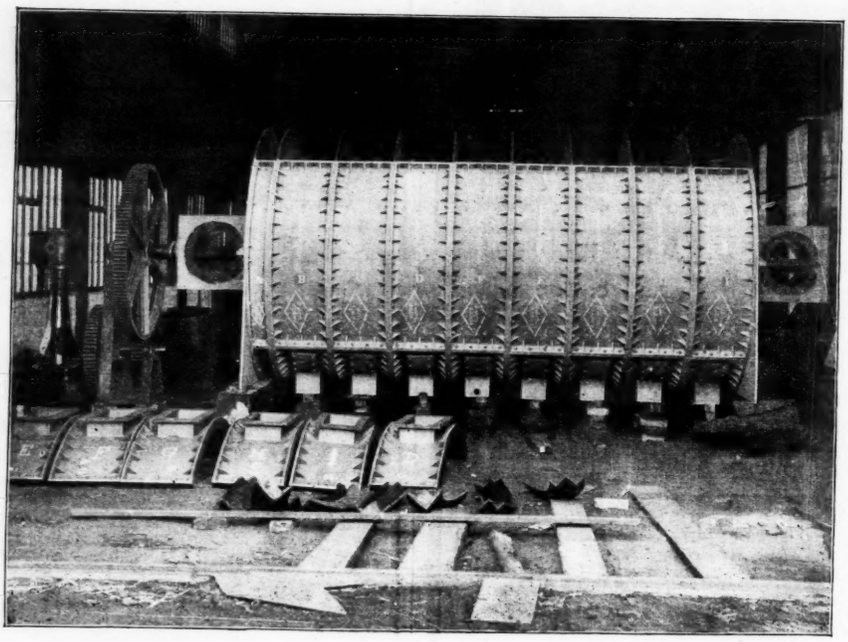

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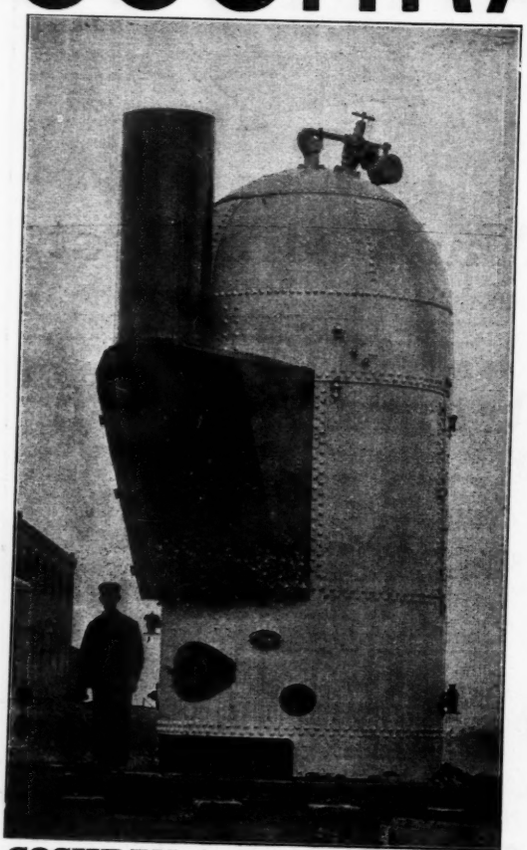

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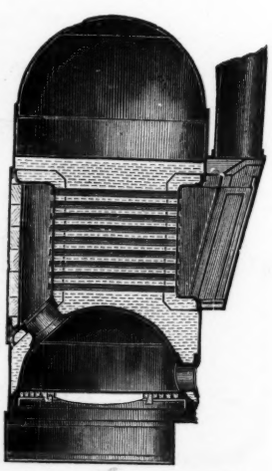

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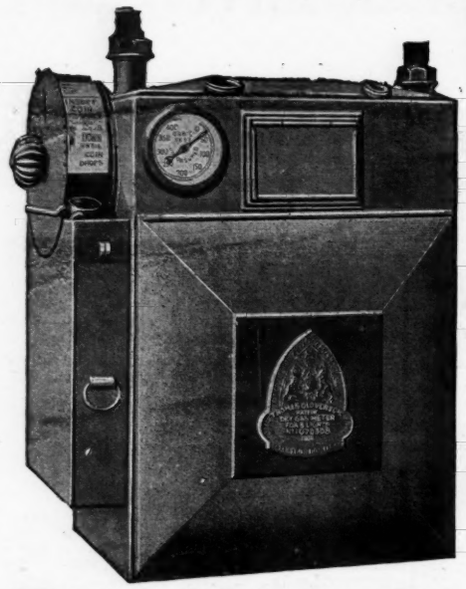

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EDITORIAL NOTES—GAS, &c.

The Metropolitan Companies and Gas Testing—The Latest Phase.

THERE is not the slightest reason for supposing that the Metropolitan Gas Companies are otherwise than entirely satisfied with the decision of Lord Rosse's Committee, which unmistakably confirms the *status quo*, or that they desire anything more than the continuance of the existing method of testing for illuminating power. It is the London County Council who, taking advantage originally of a legal difficulty in the way of the adoption by the Gas Referees of the South Metropolitan method for testing the gas supplied by the Commercial Company, and since then persistently seeking to impose on both these Companies a method of testing which is at variance alike with common sense and with justice, now seek to cover their defeat in the rejection of the Departmental Committee's recommendation by a proposal which, whatever the shape it may ultimately assume, cannot but be to the advantage of the Gas Companies and to the corresponding disadvantage (from the Council's own point of view) of those whom the Council are supposed to represent. In plain language, they are believed to be willing, if only they can "save their faces," to betray the interests entrusted to their charge. In these circumstances, it is scarcely for the Gas Companies to refuse what is held out to them so invitingly by their deplorably weak opponents. To do so would probably be regarded as Quixotic on their part. It is not for them to consider what is best for the London County Council, but rather what is best for themselves—always bearing in mind that they and the consumers are indissoluble partners.

The "JOURNAL," however, has a duty, independently of either side in this controversy; and this duty it owes to its readers to perform impartially. Let it, then, be said at once that, however much we may rejoice at the success of the Companies, and though as regards the London County Council, the general verdict would undoubtedly be, "Serve "them right," we should nevertheless consider it to be the reverse of a matter for rejoicing if the former were, in the result, to be gainers from the present exigencies, real or imaginary, of the latter body. It is quite true that the advantage will have been none of their seeking, and that the London County Council will have brought the result on themselves. None the less, it would, it is to be feared, be a source of bickering and dissatisfaction in the future which is to be avoided if by any means possible. A settlement that shall leave no aftertaste of bitterness is greatly to be desired. The London County Council have, in reality, no alternative, in the interests of good government, but to submit to the will of Parliament. There is no sort of compromise open to them, and at the same time acceptable to the Companies, that would not touch their honour as a public body.

As was pointed out last week in these columns, the substitution of either of the two existing 14-candle burners for the "London" argand would give a substantial advantage to the Companies; and this would surely be a very high price indeed for the London County Council to pay for the retention of what is practically an obsolete method of gas testing. There is, no doubt, the alternative of a burner with an adjustable air supply. This would suit the Companies well enough; but what possible advantage would it be to the Council over the present method? Mr. Carpenter showed, in the paper which he read at the recent meeting of the Institution of Gas Engineers, that gas which, tested by the South Metropolitan method, gave an illuminating power of 14·28 candles, yielded as much as 15·87 candles when the air supply was suitably adjusted; while the results obtained from another sample of gas were similarly increased from 14·17 to 16·22 candles. Like results are to be obtained by the use of shorter chimneys than the statutory one of 6 inches; and this expedient is in some respects to be preferred to Mr. Carpenter's. For one thing, when once the right height of chimney is determined, it is unalterable, which could hardly be said of any arrangement of variable cut-off for the air supply. Both are, however, open to the objection that they tend to limit the range of the burner, and would defeat the general desire for a uniform method of testing, since it is doubtful if they yield results that are comparable. On the other hand, the adoption of either a fixed height of flame or a fixed illumination renders the standard argand suitable for testing all kinds of common gas. The latter, when limited to 16 candles, does not, it is true, develop the capacity of the burner to its fullest extent; but it is regarded by all as a convenient, practical, and scientific method, and one that is at the same time just to all qualities of gas from 16 candles downwards. It is approved by the Gas Referees, and has been endorsed by Parliament. Only one thing is wanted in order to secure its adoption as the universal method of gas testing, and that is its full recognition by a public body whose name should stand not only for enlightenment and progress, but also for fairmindedness in all things.

The Annual Congress of the Societe Technique.

THERE was a good attendance of members at the 32nd annual congress of the Société Technique du Gaz en France, which was opened in the Town Hall, Havre, last Tuesday, under the presidency of M. Georges Visinet, the Manager of the St. Germain Gas Company; and in another part of the "JOURNAL" will be found a general report of the proceedings and an account of the visits and excursion. The congress extended over four days; but only a portion of Tuesday afternoon and the mornings of Wednesday and Friday were devoted to the delivery of the President's address and the reading and discussion of papers, of which there were 24 on the *agenda*. Many of them, however, were, as in previous years, very short; and none assumed the formidable proportions of those to which members of the Institution of Gas Engineers are accustomed. They nevertheless, as will be seen, covered a variety of interesting subjects. The President's address consisted chiefly of a review of the past work of the Society; but it embraced other topics in which the gas industry are concerned. It was listened to with marked attention, and its salient features were received with applause. The list of papers was headed by one by M. Naudé, one of the Sub-Engineers at Havre, on a subject which Mr. Riley brought forward at the recent meeting of the Institution of Gas Engineers—viz., the lighting of railway carriages by compressed coal gas; and the others dealt with carbonization, coke conveying, producer gas making from coke and breeze, workmen's remuneration, inverted gas-burners, automatic lighting, the action and stamping of meters, pyrometry, and the photometry and calorimetry of gas—the two last-named subjects enabling M. Lecomte to exhibit and explain the action of his new petrol standard and a calorimeter. If among the communications there was not one to which the expression "epoch-making" could with justice be applied, collectively they will constitute a useful addition to the Society's Transactions. Three of the papers were not taken, owing to the absence of the authors, and many were not discussed. We shall not offer here any comments upon the papers; but opportunity may be taken for dealing with them in a subsequent issue.

Turning from the technical to the social items in the programme, many of our readers are no doubt aware that Havre is the largest station of the European Gas Company; and it may be remembered that when the Société Technique decided to hold their meeting in the town this year, the Directors determined—and the shareholders supported them—that the Company should be the hosts of the members during the congress. This determination was expressed by Mr. H. E. Jones, when presiding at the annual meeting of the Company last July, in the absence through ill-health of Mr. Hesketh Jones, the veteran Chairman, by whom it was reiterated on the occasion of the dinner at the Hotel Cecil last December, when the international gathering of gas engineers at Earl's Court took place. It is scarcely necessary to say that the duties they had voluntarily taken upon themselves were discharged with true English liberality. The entertainment on Tuesday night and the delightful excursion on Thursday left nothing to be desired; and it was gratifying that on both occasions Mr. Hesketh Jones was able to be present, personally receive the guests, and address to them in their own language a few words of hearty welcome. Some of the members had had experience of British hospitality on their visit to Brighton and London after the Dieppe meeting; and they found that it was not less liberal now than then.

Apart, however, from their experience of the European Gas Company as hosts, the members of the Society must have carried away with them another which is of far greater importance to the gas industry at large. They found at Havre an English Company who are carrying on a commercial undertaking in various towns in a foreign country, and doing it satisfactorily and successfully. We have had occasion, at various times, to allude to the difficulties necessarily attending such an enterprise. The renewal of a concession, a movement in favour of the introduction of a competitive system of lighting, interference with traffic by the opening of roads—all these, and many others, are events when not only is cautious administration needed at the central offices, but the utmost skill and *savoir faire* on the part of the local representative. Lack of the latter might prejudice the interests of the concern to an extent for which no amount of engineering ability would make adequate compensation. The members of the Society must have returned to their homes fully conscious that their hosts are well served in this respect, at all events at Havre. Testimony was borne by the Mayor, M. Maillart—on the opening day of the congress, and again at the banquet on Wednesday—to the good relations subsisting between the Municipality and the Gas Company, "*grâce à la courtoisie et à l'aimable empressement de son estimé directeur, M. Gaston Gautier.*" It is this combination of amiability of disposition with resoluteness in action which makes the *doyen* of the Engineers in the service of the European Gas Company so valuable an officer. It is a union of qualities which Lord Chesterfield—a man who, it will be acknowledged, knew something of the world—confessed was more exceptionably useful in every walk of life than any other. And what was said by M. Maillart in regard to Havre could, we conscientiously believe, be affirmed with respect to all the Company's other Engineers. Their relations with their respective Municipalities and the officials serving them, are of the most cordial character; and their stations are operated by employees who are willing to give the Company their best work.

We hear a good deal nowadays about the *entente cordiale* between France and England. Long may it exist. But it is only a very few years ago that the expression was not so generally heard as now. There were those who seemed to wish to see the two nations at enmity—even at war—and who tried very hard to stir up strife. What has brought about the changed feeling on the other side of the Channel? In a large measure, if not mainly, by the display in an exalted position of the very qualities to which we have been referring. Their exercise has been unquestionably beneficial at Havre, and similar results should be attainable by the same means elsewhere. These observations on the pleasant gathering of gas engineers in France's second seaport last week may be fittingly closed with the expression of a hope that its outcome may be not only the strengthening of the relations between English gas companies on the Continent and the municipal authorities with whom they are in many places associated, but the closer union of the gas engineers of both countries, and the advancement of the gas industry generally.

The Manufacturing Costs of Granton.

We complete to-day the study commenced last week of the paper which Mr. W. R. Herring prepared for the Institution meeting, but which unfortunately was both taken as read and no opportunity given for oral discussion, though written communications were invited. The two cognate subjects, however, embraced by the contribution are too important in their bearing upon economical working in the gas industry for such abrupt and unconventional treatment; and therefore no apology is needed for the extended examination given to them in the present and last week's issue. We venture to hope that these articles will—if the paper itself has not already done so through its inclusion in the plethora of technical material yielded by the meeting—revive interest in the Granton combination of plant, and draw attention to the distinguished results obtained by that plant as recorded in the tables. In thus directing attention to these matters, it must not be supposed that we are in any way contending that the Granton combination of design and method is the only one by which equally good results can be achieved. The great point is that the designer of Granton has more than justified himself and his works by the fulfilment of his most sanguine expectations. Critics of his scheme were at its outset very busy with their prophecies; but there appears to be no particular haste to criticize, or even seemly desire to applaud, now that Mr. Herring has furnished for the second time his working costs with, we think we may say, unparalleled fulness and minuteness.

But beyond their significant justification of the Granton scheme, the figures have a particular appositeness as a commentary on the address delivered by the President (Mr. D. Irving) at the meeting of the Institution, or rather upon the conclusions which he drew from his elaborate workings to obtain averages from an aggregate composed of the best and worst workings, and all that are intermediate. It was rather singular that it should have been the President himself who pressed Mr. Herring to read a paper on the subject of the Granton working costs, and that the paper should be the ready means of acting destructively upon the statistical fabric which the President had so laboriously constructed. And now that the study of Mr. Herring's Granton figures has been completed so far as there is any present intention on our part of investigating them, we are urged with more force than ever to ask, Why should these or other engineers' notable manufacturing results, due to their works' schemes, types of plant, and methods of operation—not alone in respect of their carbonizing plant—be lost among averages which the less favourable results down to the very worst raise considerably above their own superlative figures. It is these engineers, and these only, who can prove that (to quote from the President) "the industrial economics of the "industry" have not—as Mr. Irving would have us believe they have—remained *in statu quo;* and it is their right that this should be acknowledged, and then let who will among those who cannot show such auspicious returns follow them. By doing so, if there is any intrinsic value in such averages as Mr. Irving set out in his address, those averages will as time advances be greatly improved by reduction.

Whether Granton is judged upon the figures as a whole, or whether the figures are dissected and allocated to their component parts of the scheme, the results are of a character upon which nothing but congratulations can be extended to both the Gas Commissioners and their skilled Engineer. To the extent that we have, in the article elsewhere, drawn upon the figures to ascertain the carbonizing costs, an attempt has been made to co-ordinate them with English practice by making certain exclusions, all of which are distinctly specified, in order that no confusion may arise. By doing this, it will be seen that we arrive at the remarkably low carbonizing cost of 1·69d. per 1000 cubic feet; and even then—the items constituting the 1·69d. being clearly defined—it will be remarked that it still contains certain charges which are not commonly included in such costs by the engineers of some of our English gas-works. If those charges were also deducted, the carbonizing costs would be further reduced to 1·303d. With such an analysis as is presented to us in the paper, no mistake can be made (as has so often been made in connection with other published costs) as to what is comprised in the figures; and, from the full analysis, whatever may be the views of an engineer as to what should or should not be incorporated in the total of carbonizing costs, he can very readily compare his own with Granton

working. This most working accounts do not, through insufficient subdivision, enable anyone to do. However, we have dealt extensively with these various matters in the comments elsewhere, and have shown that to the credit of Granton stand not only very low manufacturing costs, but several other financial advantages which Edinburgh and Leith are to-day enjoying, through the bold but confident step taken by the Gas Commissioners and their Engineer but a few years since. From the engineering standpoint, the honour of to-day is Mr. Herring's; but no less does honour rest upon the Commissioners, for without their confidence, support, and encouragement, the comprehensive scheme with its definite goal would have failed in consummation and attainment.

Standards of Light—Ideal and Real.

THE day when Parliament shall have ceased to prescribe a standard "illuminating power" for the product distributed to the public by gas undertakings cannot now be regarded as in the far-away future; for it has come within almost measurable distance since the dawn of the twentieth century. At present, however, very few gas undertakings are wholly free from statutory restrictions in this respect, and only comparatively few more are free from the responsibility attaching thereto owing to the enlightened action, or rather inaction, of local controlling authorities. Hence the standard of light, by reference to which the illuminating power of the gas distributed will be assessed, has still a real and almost dread importance to most gas managers. Apart, however, from the forbidding aspect which the standard of light and the whole apparatus of photometry are thus made to assume in his sight, the gas manager should have a vital and continuing interest in the standard and the photometer, because they are the means whereby the modes of applying gas to the production of light must be compared and their relative values and efficiencies determined. For this reason, readers of the "JOURNAL" should not turn impatiently away from the valuable contribution on the "Present "Position of Photometric Measurements," prepared by Mr. A. C. Jolley for this year's Optical Convention, and reproduced in another part of this issue. The paper deals first with standards of light and later with photometers; and it is only on the former portion that we now make a few observations. After reviewing many and varied standards of light, including all the more important and a host of failures, Mr. Jolley draws conclusions of which the substance is as follows: That the ultimate light standard will probably be a body in a definite state of incandescence—the most promising being platinum at its point of solidification; that flame standards are unsuitable as ultimate standards, on account of atmospheric difficulty in burning the fuel under constant conditions; and that the modern pentane lamp and the Hefner lamp are the best and most reliable flame standards. The Hefner lamp is somewhat the better, because its constants have been carefully determined.

The platinum standard, originally conceived by M. Violle, which is thus again suggested as the ultimate standard of reference, can admittedly as yet be reproduced only with the greatest difficulty and with a large margin of uncertainty as to its value. Nevertheless, we may concede that some such standard may ultimately be found to be more tractable and of virtually constant value, and therefore suitable for adoption as an ultimate reference standard at the National Physical Laboratory and the kindred institutions in other lands. At the present time, however, the best standards of reference are still flame standards, of which the Harcourt pentane lamps and the Hefner amyl-acetate lamp are the best known and, on the whole, the most acceptable. As to these, the various types of pentane lamps devised by Mr. Harcourt are almost too numerous to mention—we believe he has brought before the public three one-candle and four ten-candle pentane standards—and a good deal of confusion has arisen through partially informed writers crediting the faults and qualities of one type to another. Mr. Jolley blunders in applying the corrections for height of flame with variation of the barometric pressure, which pertain solely to the one-candle air-gas flame, to the later one-candle portable lamp. It is obvious that Mr. Jolley has not attempted himself to apply these corrections, or he would at once have discovered that they were inapplicable to the lamp with which he associates them. And perhaps we may say that there are other evidences in this portion of his paper that Mr. Jolley writes rather as a diligent compiler of the observations of others than as one who has had practical experience of the majority of the standards described. Nevertheless, he has done good service in setting forth the *pros* and *cons* in respect of them; and few photometrists will fail to benefit by a study of his communication.

In conclusion, a word may be said as to the relative merits of the pentane and the amyl-acetate lamps. For practical purposes, the only pentane standards which need be considered are the one-candle air-gas flame, which is valuable only as a reference standard, and the Harcourt ten-candle lamp, which became the official standard in the Metropolitan gas-testing places in 1898. The latter is eminently a working standard; and it has many manifest advantages over the Hefner amyl-acetate lamp, especially to English photometrists. Primarily, it is an exact multiple of the average value of the English standard sperm candle, of which the Hefner unit represents only 0·877. Then in regard to colour and intensity it is immensely superior. A standard light of less than one-candle value is quite unsuitable for determining the intensity of sources of fifty candles and upwards; and in these days of high-power lights—both gas and electric—a large proportion of technical photometry is concerned with nothing less. For these reasons, the ten candle pentane lamp is likely to continue to be preferred by our photometrists to the Hefner lamp; and the one reason Mr. Jolley gives for favouring the latter—namely, that its constants have been so carefully determined—is of no intrinsic weight. It should not be difficult for the National Physical Laboratory to continue its work in establishing constants for the Harcourt lamp; and it is imperative that this work should be put in hand and finished with all speed, either there or by some capable observer elsewhere. Then the one tangible objection which Mr. Jolley raises to the use of the standard by which the illuminating power of probably a moiety of the country's production of gas is tested would be removed, and electricians would have to seek another excuse for stating the lighting power of their lamps in (Hefner) "candles."

Municipal Trading and Retaliation.

If an article which has lately appeared in the "Birmingham Daily Mail" is accurate—and there is no reason to believe it is not—the Gas Department of the city are threatened with some trouble in their fittings business. It is reported that the celebrated plan of campaign of which Captain Boycott was the first victim, and which for years played such an important part in connection with the land agitation in Ireland, is to be introduced first of all in Birmingham, and then "throughout the length and breadth of the country, wherever corporations carry on any form of trade which directly competes with the business of private traders." It is asserted that the Corporation have of late years so largely extended their gas-fittings business, that private trade in these useful articles has been practically ruined; and it is in consequence of the feeling that some drastic measure must be taken to combat this Corporation competition, that the step referred to has been taken. In futherance of this object, a secret compact has been entered into, whereby all tradesmen who obtain gas-fittings from the Corporation, or express approval of the sort of municipal trading in which the Gas Department are now engaged, shall be boycotted. The precise terms of the "secret compact" remain a mystery—for the present; but the broad meaning of it is clear enough. A gas-fitter in the city has issued a circular, in which he states that he is busy obtaining information as to where his orders are being placed, as it is his intention to close accounts with those who are in favour of "the iniquitous system of rate-aided competition" referred to; and he strongly urges everyone to do as he has commenced to—that is, retaliate. He says he has petitioned the Corporation for years; and that if it had not been for his manufacturing business outside Birmingham, he must have succumbed, as it is absolutely impossible to carry on a successful business under such circumstances as exist in the city to-day."

An Attempted Boycott.

The author of this wonderful document goes on to announce that he and three friends have been able, without any outside help, to boycott twenty-nine "tradesmen." A list of these unfortunates is appended, and shows that the favour has been distributed with the utmost impartiality. It includes four publicans,

an architect, a newspaper, two charity organizers, a stockbroker, and two gas-stove manufacturers. The precise extent to which these individuals have been made to suffer, is not indicated; but we opine that the "boycott," as yet at any rate, must be a very mild sort of affair as compared with the fate that overtook those who were luckless enough to incur the wrath of the Land League in its palmiest days. The outcome of the struggle will, however, be watched with interest by both municipal and private traders. Into the merits of the question it is not necessary now to enter; the reasons which have induced companies and corporations to take up the gas-fittings business are too well known to require repeating. The present agitation seems, to some extent at least, to be the outcome of a letter written on behalf of Mr. Chamberlain, and published in the "JOURNAL" a few weeks ago, in which the statement was made that when the Gas Companies were bought up by the Corporation they were doing a certain amount of fittings trade, and this was continued by the Corporation with the rest of the business; "but there was no intention of enlarging it or of carrying it on with any view to profit." Sir Hallewell Rogers, the Chairman of the Gas Committee, denies that there is any desire to compete unfairly with private tradesmen; but on the other side it is contended that the department undersells private traders, who have no means of knowing whether the fittings branch is worked at a profit or at a loss. Altogether, whatever may be the rights of the question, one cannot help thinking that these would-be boycotters have put their hand to a pretty big job. To punish tradesmen who obtain fittings from the Corporation may be possible; but putting the screw on those who "express approval" of this sort of municipal trading seems to be a very much larger order. Most forms of municipal trading compete with the ratepayers in some way or another; only when the sufferers happen to be a company who do not even have a voice in the disposal of the sums which they contribute, very little attention is paid to this aspect of the matter.

The Compensation Act and Malingering.

Some statements have lately been made which are worth noting, with regard to the effect of the Workmen's Compensation Act in inducing men to remain away from their employment after an accident for a longer time than they might otherwise do. Under certain circumstances there is a temptation to malinger; and it seems that sometimes workmen are not strong enough to resist when assailed by it. The result of this is to make the Friendly Societies sufferers, when the fallen ones happen to be drawing sick-pay by right of their membership of one of these bodies. The Grand Treasurer of the Order of Druids stated at their recent meeting that statistics which had been compiled showed there had been a large increase in sickness since the Compensation Act came into operation. He did not contend that it was not legitimate sickness; but he did say that it was sickness which, but for the Act, would perhaps never have resulted in claims upon their funds. It was not hard for a man to persuade himself that he should come upon his club for sick-pay; and the temptation was all the greater when there was also income to be derived from other sources. A member, however, said he did not think the Act had produced malingering to any great extent. It had enabled men to obtain sick-pay when they needed it, and to remain from work until they had quite recovered from illness. Formerly they had not been able to do this. The report of the Directors of the Manchester Unity of Oddfellows suggested that to meet the heavy claims which had fallen on lodges composed of men engaged in dangerous occupations, it would be better to reduce the sick-pay while members were in receipt of income under the Compensation Act rather than raise the contributions so as to cover the liability. The Grand Master said that minor accidents in the colliery districts were not a decreasing quantity; and the number of days men remained away from their occupation as a result of these accidents was becoming greater. The suggestion that the claims upon Friendly Societies had not been increased by the operation of the Act was futile, as was proved by the reports of the Home Office Committee, Insurance Companies, &c. The proposal, however, gave rise to a good deal of opposition; the feeling of some of the members being that it would take away a statutory right which had been obtained for workmen through their trade organizations. But on its being pointed out that the clause was merely a permissive one, it was agreed to.

London Electrical Power Bills.

The promoters of the London Electricity Power Bills are not looking with any degree of composure upon the strenuous efforts that are being made to overthrow their measures; and more especially does this apply to those who are responsible for the Administrative County of London Bill. There is little doubt that they have been moving some of the morning papers, including "The Times," to plead their cause. Great activity is being displayed in opposition on every side by the London County Council, the Borough Councils, the Electricity Companies, and the Gas Companies. Members of Parliament have been circularized by some of the opponents, and municipal authorities throughout the country have been besought to bring their influence to bear upon their representatives to assist in giving the Bill its quietus on second reading, its introduction for which it is expected will take place to-morrow. But the promoters are urging that, as the Bill occupied Lord Camperdown's Committee six weeks, and as they have (so it is estimated) already spent not less than £60,000 over it, it is only fair to them that they should have a hearing before a Committee of the House of Commons. Quite fifty petitions have been deposited against the Bill; so that, even if it is permitted to go before a Committee, there will be another long and lively inquiry before we shall know its fate. The South Metropolitan Gas Company made the first attack on the Bill in the Commons, and what is more they scored a success. This was before the Examiners of Private Bills; but, of course, their decision may not be upheld. The Company presented a petition alleging non-compliance with the Standing Order as to notices, on the ground that "the Bill having had certain amendments made in the House of Lords," the notices which had been given by the promoters were insufficient. This contention was upheld by the Examiners, who decided that they must report to the House that the Standing Orders had not been complied with. There will be a reference of the matter to the Standing Orders Committee, and to them a memorial will be presented by the promoters, praying that the Standing Orders may be dispensed with. Many eyes will be anxiously watching for the development of this matter.

"The Gas and Oil Engine Record."

We welcome the appearance of a new monthly journal which is to be devoted to the gas and oil engine industry, and edited by Mr. W. A. Tookey, who, our readers will probably remember, is the author of certain books on the subject with which this periodical will deal. Mr. Tookey is specially interested in the use of producer gas for internal combustion engines; and we therefore assume that the "Gas and Oil Engine Record" will take up more particularly this line of work. We notice in one of the articles, on "The Starting-Up of Gas and Oil Engines," the following information respecting the comparative cost of electric motors and gas-engines: "Take the cost of current for the electric motor first. Thirty brake horse power is equal to 22·38 units per hour, and, for half-an-hour, adding, say 10 per cent. for losses in efficiency, the consumption of current would be about 12½ units, which, at, say, 1½d. per unit, would amount to 1s. 6¾d. for the sixty minutes period, supposing—as we have said—that for half the time no work was required to be done. Now for the gas-engine. It is a very poor gas-engine that would not be able to develop 30 brake horse power for 750 cubic feet of gas—say, 25 cubic feet per brake horse power hour. Taking half-an-hour at full work, the consumption would be 375 cubic feet, which at 2s. 6d. per 1000 would cost 11¾d. Supposing that the gas-engine were then to be left running for the other half-hour without load, we can safely reckon that the rate of consumption of gas would then not exceed 84 cubic feet per hour total. Thus 42 cubic feet would be added to the 375 previously accounted for, and the total cost for gas for the full hour would be 13½d.! The saving of 5¼d. thus shown in favour of the gas-engine would allow the engine to be kept going for another two hours without load, before the electric motor could begin to show its advantages in this direction. Of course, with producer gas the saving would be very considerably more." At the end of the paper there is a paragraph which states that it is estimated there are more than 80,000 gas and oil engines at work in the United Kingdom. The output during recent years has increased very rapidly; and numbers of firms now make this type of engine against the few that did so a dozen years ago. We wish our new contemporary a successful and useful career.

THE GAS STOCK AND SHARE MARKET.

(For Stock and Share List, see p. 981.)

We had to chronicle a quite bad enough state of things on the Stock Exchange in our issue last week; but the week just closed was even worse, and the position of affairs is almost disheartening. Apprehension of difficulties arising out of the Morocco question was the disturbing element; and this was felt both at home and abroad until the various Bourses seemed to be frightening each other mutually. There was a momentary check to the alarm about mid-week, but the old nervousness soon took the command again, and held on till the close. The final bargain in Consols was at 89$\frac{1}{16}$, a figure untouched for a very long time. But business all round was on a very small scale; and on some days it was next to nothing. The Money Market was easy under a very light demand, but during the rest of the half year it will find more occupation. Business in the Gas Market was really quite brisk and lively when compared with the general condition which ruled all round, and the tendency was markedly steady. Hardly any changes in quotation were effected, but they pointed in the upward direction. In Gaslight and Coke issues, the ordinary was very fairly active, and was unchanged. The best price was 100, which was marked several times; and most of the dealings were little below it, though one bargain was let go at 99. In the secured issues (which were moderately active) business was done in the maximum at prices ranging from 92$\frac{1}{4}$ to 93$\frac{1}{4}$; in the preference at from 109$\frac{1}{4}$ to 110$\frac{1}{2}$; and in the debentures at from 89$\frac{1}{8}$ to 90. South Metropolitan showed considerably more activity than it has recently displayed, and realized 128$\frac{1}{2}$ to 129$\frac{1}{2}$. The debenture changed hands at 91$\frac{1}{2}$. No business was recorded in Commercials, but the quotation of the 4 per cent. stock was advanced a point. The Suburban and Provincial group notably contributed towards the array of dealings in the week; there being something almost approaching a revival of interest in this strong and substantial branch of the undertakings. Alliance new was done at 14$\frac{1}{4}$. Brentford old marked top price, 252; and dealings in the new ranged from 188 to top price, 190. Brighton original was done at 229, and ditto ordinary at 168. British commanded 40$\frac{1}{4}$ and 40$\frac{3}{4}$. Dealings in South Suburban were at 122 and 122$\frac{1}{2}$, and ditto preference at 124$\frac{1}{4}$. West Ham preference realized 123$\frac{3}{4}$. On the local Exchange, Liverpool "A" and "B" had a rise of a point each. In the Continental Companies, business was not abundant. Imperial prices ranged from 211$\frac{1}{2}$ to 213, mostly at the lowest figure. Union marked 109 and 110. European was done once at 22$\frac{3}{8}$. Among the undertakings of the remoter world, Bombay changed hands at 6$\frac{5}{8}$. Cape Town was done at from 17$\frac{1}{8}$ to 17$\frac{3}{8}$, ditto preference at 10$\frac{1}{8}$, and ditto debenture stock at 102. Hong Kong was marked at 18 and 18$\frac{1}{8}$. Dealings in Buenos Ayres were at from 11$\frac{3}{4}$ to 12, and in River Plate at from 12 to 12$\frac{1}{4}$. Primitiva ordinary marked 5$\frac{3}{4}$ and 5$\frac{15}{16}$, and ditto preference was fractionally easier at 5$\frac{1}{16}$. San Paulo was done at 12$\frac{7}{8}$ and 13. Melbourne 4$\frac{1}{2}$ per cent. changed hands at 102.

The closing prices are shown in our Stock and Share List on p. 981.

ELECTRIC LIGHTING MEMORANDA.

A Depreciation Fund Lesson from Sheffield—Past Neglect, Present Regret—An Unconvincing Report on Public Lighting—Unauthorized Excesses of Capital Expenditure.

The position of the Sheffield Corporation electricity undertaking offers a fine lesson for municipal administrators respecting the establishment of reserve and depreciation funds in connection with such concerns. A condition of affairs has been unfolded to the ratepayers which shows them with an undischarged load of capital expenditure, unrepresented by assets in any shape or form. This is not an unusual condition (if people would only recognize it) of many municipal electricity concerns, whose funds—either because they are insufficient, or because the craving for profits "in aid of the rates" swallow up the surpluses—will not permit of adequate provision being made for replacements; and hence the capital account goes on swelling at a most alarming rate, and much of it has nothing of a tangible nature to represent it. Those light-hearted town councillors who ridicule, and cry "pessimist" to, anyone who exhorts them to be circumspect in the matter of making proper provision, have their reply from Sheffield. The Corporation Electricity Committee, as we stated last week, have to own to a deficiency on the past year's working; and the General Manager (Mr. S. E. Fedden) holds out no prospect of any great improvement for the current year. The capital account must now be in the region, or nigh to it, of £800,000. There is, however, in hand only about £20,000 of accumulated surplus profits; no reserve or depreciation fund. Rather late in the day, the Chairman of the Committee, when the accounts were recently before the City Council, announced that he would now like to see anyway a reserve fund established. No doubt. The possession of a substantial reserve or depreciation fund, or better still both, would have saved the undertaking from the serious financial situation into which, it cannot be denied, it has dropped through past negligence. The warning that the working life of electrical machinery does not synchronize with the period of the repayment of capital, has been scouted; and the meeting of sinking fund and interest obligations, together with payment out of revenue for current maintenance, has been treated as being abundantly sufficient. That idea was exploded by a revelation made by Alderman Styring reading, at the meeting of the Council, a statement which certain members of the Electric Lighting Committee had obviously desired should be concealed from the public. It is worth reproducing—

> Capital account as taken from the Sheffield Electric Light and Power Company, Limited, on Dec. 31, 1898, and which has since become obsolete, antiquated, or not existing, March 31, 1904: Buildings, £309; machinery and plant, £24,243; mains and services, £12,403; transformers, £7828; meters, £3419; instruments and tools, £780; general stores, £1473; cost of Licence, £334; library account, £49; formation expenses, £1222; wiring and fittings and factory, £1844; premium account, £143,635—giving a total of £199,575.

The annual instalment for interest and sinking fund on this capital, unrepresented by anything of a tangible nature, is given as: "Interest (40 years' accumulations), £5987; sinking fund, £5483—total £11,470." And yet included in this are charges for plant not now existing, and therefore not now earning anything. Capital expenditure, for which provision has also to be made, has been going on heavily since the undertaking came into the hands of the Council; and, as stated above, it must now total between £750,000 and £800,000. Therefore the undertaking of the present has to furnish profits enough to pay sinking fund and interest not only on capital that is represented, but on that which is unrepresented. However, the Chairman would like to see a strong reserve fund, which he would prefer to what he is pleased to describe as "an imaginary or fictitious sum in the nature of a depreciation account." We cannot understand a depreciation fund that is "imaginary or fictitious." But now that a reserve fund is so earnestly required, or the writing-off of large sums for depreciation is imperatively necessary if the concern is to be restored to a sound condition, the question arises, Where is the money to come from? The price of electricity must either be increased, or the undertaking must fall back on the rates. The former cannot be contemplated, if only for the reason that the price of gas in Sheffield is at an exceedingly tempting figure for consumers; and therefore the Electric Lighting Committee are looking around to see what can be done. Into futurity, one is not permitted to penetrate far; but calculating from present rather unmistakable signs the lessening of the charges to the consumers of Sheffield cannot be detected, and the establishment of a reserve or depreciation fund in any immediate period is a shadowy event. Congratulations on their financial position has been made from certain quarters to the Electric Lighting Committee. The ground for this, in present circumstances, appears to us to be somewhat "imaginary or fictitious."

There were references at the Council meeting to the General Manager of the Electricity Department (Mr. Fedden); one of the members advising that gentleman, for the behoof of the undertaking, to be for a time more of a commercial man than an engineer. No doubt many electrical concerns are suffering from the want of the faculty in engineers to combine a good commercial spirit with that of engineering. But the matter with which we have to specially deal here is a report which has recently been issued by Mr. Fedden. In this report, he recommends a scheme for the arc lighting of the main thoroughfares of Sheffield, and urges the importance of putting electric lamps into the shopping districts, as by that means he is convinced he will secure for the department many new private customers. That strikes us as being rather an expensive method of going to work to gain new custom, seeing that a heavy capital expenditure is involved, and the ratepayers will have to pay unduly for the arc lighting. The report is one which the councillors should look upon with some suspicion, seeing that the statements in it do not accord with what is admitted to have been the very general experience of municipalities in the matter of public lighting by electricity. With its adoption, the cost of this public service has gone up by leaps and bounds. Therefore the Sheffield Corporation may be advised to look closely into the record of experiences; and it will be a singular thing if they do not come out of the exercise profoundly thankful that they have not been tempted to lay upon the ratepayers, through the electricity concern, greater burdens than those which now threaten them. They might, by way of commencement of their examination, look into the experience of the City of London.

Mr. Fedden is amusing in his inaccuracies concerning incandescent gas lighting. He declares that the bulk of the light is not supplied below the horizontal. We will say nothing more about this than that he errs, and that nightly thousands of incandescent gas-lamps in London are demonstrating his mistake. Another drawback, he says, is "the necessity for frequent changes of the mantles; the light falling off very rapidly after the first few hours." Again he errs; and, through such mistakes, he testifies to his unreliability as an adviser in these matters. We have the testimony of many municipal engineers that in the public lamps the consumption of mantles, according to the position of a lamp in regard to traffic and exposure, vary between two and a dozen a year per lamp—the higher figure applying, of course, to badly situated lamps. With high-pressure lighting, the consumption may be more, but even then it is not extravagant. When Mr Fedden says that the light falls off "very rapidly" after the first few hours, we assert without scruple that it is not an accurate and

fair statement. The third drawback, according to Mr. Fedden, is that "unless expensive and elaborate lanterns are provided, the gas mantles are very susceptible to the wind." Mr. Fedden has much to learn about these things. For a very modest sum, old gas-lanterns can be made quite wind-proof; and for a very moderate expenditure our lamp makers are prepared to supply lanterns suitable for the principal thoroughfares of any city, and which will make a vast improvement, for a tithe of the expense that would be incurred for an installation of electric arc lamps.

Mr. Fedden does not appear to be particular as to the data with which he supplies the councillors as to the comparative costs of electric arc lamps and gas-lamps. When one of the electrical papers tells us that "comparison" of the figures "becomes troublesome and odious," what must those figures be to the town councillors? Mr. Fedden makes a remarkable comparison between 5000-candle power electric "flame" arc lamps and 2100-candle power Lucas gas-lamps, wherein he finds that the cost per 1000 candle-power-hour in the case of the former is 0·354d., and in the case of the latter 0·467d. How wonderful! Why did not this ingenious gentleman take electric arc lights more compatible with ordinary requirements and more consistent in illuminating power with the gas-lamps for the purpose of working out costs with such extreme fineness? Where, excepting in extraordinarily large open spaces, are centres of light of 5000 candles required? And if the Lucas lamps in illuminating power are all that the situation demands for its efficient lighting, then they work out considerably cheaper than the 5000-candle power "flame" arcs. It is singular that Mr. Fedden did not take the simple course (seeing that the town councillors would have understood the computation better) of showing the comparative cost of lighting per mile of street by suitable arc lamps and incandescent gas-lamps, and give the items constituting the total, instead of perplexing the councillors with such figures as those with which he presents them? The whole of Mr. Fedden's report is diametrically opposed to the greatest experience. That he lacks the necessary acumen of a pleader is evidenced by the fact that he devotes eight pages of his report to showing that 222 towns only boast in their public lighting a total of 18,925 electric arc lamps, which works out to an average of only about 85 each. But it is a significant fact that of those 18,925 lamps, 17,209 are the property of councils possessing their own electric lighting undertakings, while the balance of 1716 are in towns where the electricity supply is in the hands of companies. The lesson of this is—Mr. Fedden avoids the pointing of it—that the councils with electricity concerns patronize their own shop, but to a surprisingly small extent (yet more than sufficient for the pockets of the ratepayers), while the local authorities who have a choice of shops go to the cheaper one. One of our electrical contempories, we fancy, is rather astonished that Mr. Fedden should have given himself away in this fashion; for it remarks: "Unless it be to show that corporations are ten times as enlightened as companies, the purpose of this analysis is not evident. Perhaps enlightened self-interest has something to do with it, since the corporations are their own customers for street lighting." That is excellent, and is the truth of the matter. The Corporation of Sheffield will be well advised not to accept Mr. Fedden on public lighting without very close scrutiny. That gentleman may think his report a very clever one. Its cleverness can only be found in its omissions; in its, for laymen, confusing statements; and (if it is clever to be inaccurate) in its inaccuracies as to incandescent gas lighting.

It is getting quite a common occurrence for municipal authorities to over-spend their sanctioned loans on electric lighting works; and it is time the Local Government Board took steps to prevent local authorities setting at naught the central authority by such flagrant excesses of power. In a couple of pages of an electrical journal a week or so since, we noticed three Authorities were applying for loans part of which in each case is for excess expenditure over loans already sanctioned. There was Bath, asking for a loan of £19,000, £9000 of which was for outlay already incurred; Worcester also wants £6009 to cover expenditure in excess of loans granted; and Burton-on-Trent have asked for a sum which includes £5611 already spent. There is little use in inquiries if local authorities can indulge in expenditure to this extent without previous authority. The excesses also suggest a laxness in the making of estimates.

Mr. J. Tweedale, who was a Director of the Harrogate Gas Company, and ex-Vice-President of the Leeds and Yorkshire Architectural Society, died leaving estate valued at £34,014.

The Willey Memorial Fund.—In accordance with the decision reported in the "JOURNAL" for May 23 (p. 506), the Willey Memorial Fund Committee will invest a sum of £300 in the names of the Mayor and Sheriff of Exeter. The income is to be applied as a scholarship tenable at the Royal Albert Memorial College, Exeter (to be known as "The Willey Scholarship"), in memory of the late Mr. H. A. Willey. A wall marble tablet is also to be erected at the College, recording the public virtue and private worth of the deceased. No man in the present generation did more for Exeter than the late Mr. Willey in equipping young men for trades and professions, said the Mayor; and the manual school which the city now possesses is a standing monument to his foresight, his initiative, and the regard for others which was the dominant feature of his all too brief but useful life.

ANNUAL REPORT ON FACTORIES & WORKSHOPS.

As usual, Dr. Arthur Whitelegge, the Chief Inspector of Factories and Workshops, has a good deal to say in his report for 1904, just issued. The work of his department is on the increase; the factories and workshops on the registers being considerably more than in 1903. Last year, the figures were 104,472 factories and 145,172 workshops; the approximate number of persons employed therein being 4,000,000 and 700,000 respectively. There were received from occupiers 331,200 statutory reports, including 92,968 of accidents, 164,298 of overtime, and 32,410 humidity records; while about 37,000 more came to hand from certifying surgeons and medical officers of health. Reference is made in the report to the memorandum dealing with carbonic oxide poisoning and the use of water gas and other gases in factories, which was published in the "JOURNAL" for Oct. 11 (p. 120); and the statement is made that "the Matlock and District Gas Act, 1904, like other recent Acts authorizing the manufacture and distribution of gas containing large proportions of carbonic oxide, requires that the proportion shall not exceed 14 per cent., and that the gas shall be odorized." The Inspectors of Factories, it is added, are charged with the duty of enforcing these conditions in factories and workshops. The annual total of accidents reported under the Factory Act rose from 92,600 in 1903 to 92,968 in 1904; but there was a reduction in the number of fatal accidents from 1047 to 1018. Pending revision of the special rules for chemical works, additional precautions directed against the dangers which arise in connection with tar stills were formulated, and were last January issued to manufacturers. This notification will be found in the "JOURNAL" for Jan. 24 (p. 227). The Department found it necessary to institute 3000 prosecutions in 1904—an increase of 365 over the previous year; and four cases were carried to the High Courts. On an average about 1000 works are visited by the staff on each working day; and, of course, at every visit many different requirements of the Acts come under observation.

A few points may be noted among the divisional reports, though anything like a full review of the 370 pages of which the Blue Book consists would not be of particular interest to our readers. Under the head of industrial developments, testimony is forthcoming of the growing favour in which electricity is held as a motive power; while gas is also making strides in the same direction. A South London Inspector says, after referring to electric motors: "Another important development, which will require careful watching, is in the direction of gas production for direct use in gas-engines. A suction-gas plant, as this type of production is termed, consists of what resembles an ordinary water-gas apparatus; but there is no gasholder—the engine taking the necessary charge for explosion by the suction of its piston, practically as soon as the gas is generated. The great danger in the use of this method lies in the possibility of defective joints and fittings, whereby carbon monoxide may escape. Where accidents are liable to occur from such a cause, the danger has been pointed out to the employer and his men, so that they may be on guard. Thorough ventilation is also insisted on as a good precautionary measure." Another gentleman, in speaking of the evidences of bad trade which he has witnessed, refers to the occupiers of firewood factories in Deptford, who complain of declining business—the cause of which is stated to be the gradual displacement of coal-fires by gas-stoves. The brick-making plant of the Plymouth Gas Company is cited as a development worthy of note. From the Midland Division comes the statement that "in many quarters a preference for gas-engines over steam-engines has developed; and many of a large size are now in use. It is urged in their favour that for any given power about one-quarter of the coal bill can be saved if a modern gas-engine be substituted for even the best steam-engine; also that a gas very suitable for power purposes can be manufactured from coal at a much smaller cost than that supplied for lighting." The Inspector for Walsall says that the new suction-gas plants, making producer gas on a small scale, suitable for a single gas-engine, are cheap to operate, and appear to give very satisfactory results. He adds that they promise to run electric motors a close race in the smaller factories, as they show a distinct saving compared with town gas. At Wolverhampton, a new private power-gas plant of over 1000-horse power, for generating electricity for use on the premises, is reported; while other smaller firms have erected plants for their own engines. Several have started gas-engines (using the Gas Company's gas) to replace steam-engines; while one large cycle firm has discarded gas-engines in favour of electric motors driven from the public supply. In North Wales, the use of gas for power purposes appears to be getting popular; but as against two large firms who have substituted gas for steam, one has gone back to steam after having for a number of years used gas generated on the premises. The Inspector at Newcastle-on-Tyne observes a well-marked striving after economy in production, and an increasing willingness to spend money on plant intended to recover bye-products. Thus, he says, sulphate of ammonia and tar are frequently recovered from coke-oven gas, which until recently was extravagantly used as fuel. "Old slag heaps are being gradually crushed up for road metal, and a good surface it makes, especially if steeped in tar, which binds it and prevents, to a large extent, the formation of dust."

With reference to the ventilation of gassing rooms, one large factory at Halifax possesses an arrangement which is said to be admirable. Exhaust openings are provided a little distance above the gas-jets, and fresh air is admitted through gratings in the floor below the machines. The usual method adopted, however, appears to be that of general ventilation; and fans of great power change the air very frequently. This plan, in the opinion of the Inspector, is not so good as the one of local application, as is evidenced by the greater discoloration of the limewash on walls and ceilings, with the larger accumulation of charred fibre dust thereon. The Inspector at Oldham says that in his district fan arrangements are, as a rule, both sufficient and effective. Fresh air is usually drawn into the room under the whole length of the frames, so that as it rises it carries with it the vitiation of the burners, and is drawn out of the room by the fans (from four to six in number) fixed in or near the ceiling. This appears to him to be the most practicable means of purifying these rooms. There are a few gassing rooms in Scotland where hoods, with a fan in connection, are placed over the gas-jets; and the arrangement seems to work well. On the question of the temperature of workrooms, a Glasgow Inspector remarks that for large rooms where there is only one fireplace, a simple method which he has found adopted with satisfactory results is to place a small boiler or coil of pipes, heated by gas, in the grate, and allow the hot water therefrom to circulate through pipes round the room. One advantage claimed for this system is that the temperature can be regulated to some extent by raising or lowering the gas.

Turning to accidents, there is a report on the fatal explosion which occurred at the Saltley Gas-Works; and this is reproduced on p. 980 of to-day's issue. From South Wales comes the statement that "gas-engines still cause a great deal of trouble. Often put into a space just sufficient to hold them, their guarding is a matter of difficulty. Some think if a structure, however large, is built round a gas-engine, that is sufficient." On the other hand, in Manchester very material progress is said to have been made in the permanent and close fencing of the flywheels and other parts of gas-engines, and the adoption of an independent self-starter, or a handle for the crank-shaft, according as the engine is of large or small power. As to gas poisoning, it is stated that where power gas is made, the need for keeping cylinders of oxygen handy for dealing with cases of "gassing" is not sufficiently recognized, except by some of the larger firms; and the need is also pointed out of having trained ambulance men in all such works. One Inspector remarks that an oxygen cylinder in the hands of men unacquainted with the mode of using it, or ignorant of the means of producing artificial respiration, would be practically useless. On the subject of poisoning, another Inspector refers to suction producers, which he thinks will do much towards decentralizing such industries as have been established in certain districts on account to their proximity to a coalfield, and which have the further advantage of minimizing the dangers of carbon monoxide poisoning, since there are no chambers to be entered for cleaning purposes, and in the event of a leakage anywhere in the system air would enter the producer instead of gas escaping from it. A gas explosion, he adds, is impossible during the ordinary working of the producer, but it can happen during the preliminary starting operations. Such an accident came under his notice during the year; the attendant turning on the blower with all the valves closed, with the result that the manhole at the bottom of the scrubber was blown off. The addition of a relief valve would, he points out, remove this danger.

THE MANUFACTURING COSTS AT THE GRANTON GAS-WORKS.

In the article on the "Records of Manufacturing Costs" published last week, promise was made of a review of the matter constituting that part of the paper prepared by Mr. W. R. Herring for the Institution meeting, which bore more particularly on the title the author had chosen for his contribution. There is so much in the Presidential Address delivered by Mr. D. Irving which hinges upon Mr. Herring's paper, that we cannot avoid bringing the two into occasional close relationship. It will be remembered that, after reviewing the past twenty years' work of the gas industry, the President seemed to lament that no progress had been made towards economy in manufacturing costs. If such lament is founded on fact, it must be admitted to be both disappointing and disheartening; for, be it remembered, it is during the past twenty years that stoking machinery and other labour-saving devices in the form of plant for the handling of raw materials has been largely applied to many works. And therefore if all this capital expenditure has been incurred merely to enable the works managers to "mark time" with the past, there is surely something radically wrong, either in what has been adopted, or in the method of its application. But seriously is it so? Collectively, it is undoubtedly the fact. But there must be individual gas-works that can show better results than the average; and herein is the apparent danger of measuring progress by averages drawn from the mass. Progress in any industry is the result of individual effort; and unless such effort is treated individually, we are apt to lose sight of the advance of the pioneer.

Now how are we to find those that are individually better than the average; and how are we to ascertain what makes them so? There is the difficulty. And it is only to be surmounted by amplifying the titles under which works' costs are enumerated as advocated by Mr. Herring, and to which he devoted the major portion of his paper, and by a grouping of the works which are admittedly modern and up-to-date. In this way, the work of the best men can be compared with the best, and their collective average be of some real value as a basis of comparison with others, who from various causes continue to work obsolete plant and badly arranged works—such as in cases could, upon investigation, be shown to be financially sound to scrap, and to construct new works a possibility without adding to the consumers' burdens, but, on the contrary, permitting of their receiving a handsome reduction in the price of gas, as was the case with the Edinburgh scheme.

"Field's Analysis" for 1904 (which we noticed in the "JOURNAL" last week) shows, under the heading of "Manufacturing Charges," and taking the item under the title of "wages" (which is most commonly understood to represent "carbonizing wages" alone) the average for the Metropolitan Gas Companies to be 2·9d., and for one individual Company—viz., the South Metropolitan Company—2·44d. against the common average brought out by Mr. Irving of a little more than 3d. Similarly, the average for the Suburban Companies is 2·71d. Individually, Brentford shows the remarkably low figure of exactly 2d.; and there are no less than five others who are less than 3d. Turning to the Provincial undertakings, the Corporations show an average of 2·91d.; Manchester being the lowest, at 2·24d. The Companies show an average of 3·11d.; Bath being the lowest with 2·06d.

We are at a disadvantage in drawing an exact conclusion from these figures as a consequence of not knowing what items are comprised under the heading in question. It is therefore difficult to point the moral, and to say whether the machine-driven works of the South Metropolitan Company, with their carbonizing results of 2·44d. are better or worse than the Brentford Company, where inclined retorts prevail, with their figure of exactly 2d. This is particularly so in view of the fact that the latter works are on the eight-hour shift, whereas the South Metropolitan Company work twelve-hour shifts, under conditions of labour unique in their character, and such as are likely to considerably influence the amount of labour performed, or the actual duration of physical labour exerted by the men.

Turning, however, to the manufacturing costs at the Granton works, we are under no such disadvantage in fully appreciating what these figures comprise; for it is all set forth, with clearness and fulness of detail, in the tabulated statements accompanying Mr. Herring's paper. His statement of manufacturing costs (see Table No. 2) includes figures which are not comprised in the items of the other works already referred to. Therefore, deducting from the Granton statement the item of purification, which is clearly not embraced in the figures already cited with regard to other works, and also deducting therefrom the item of general charges—comprising office staff, weighers, storekeepers, messengers, attendants, yard cleaners, &c.—which in England are habitually charged to the repairs and maintenance account, the Granton figures show the remarkably low cost of 1·69d. for performing the operations enumerated in the following list:—

1.—Foremen (three senior and three junior retort-house foremen).
2.—Discharging waggons and coal breaking.
3.—Elevating and conveying coal.
4.—Charging retorts.
5.—Drawing retorts.
6.—Pipe-jumping, cleaning, and pointing retorts, greasing machinery, &c.
7.—Producer and ash-pit men.
8.—Hot-coke conveyor.
10.—Enginemen for coal and coke handling plant.
11. } Exhausters, gas and oxygen, and washer-scrubbers.
12. }
21.—Boilermen and trimmers.
26.—Syphon men.
9.—Heating-up retorts.
20.—Loco. men and shunters (half charged).
22.—Gasholder and pump-house men.
43.—Filling ashes and emptying at refuse tip.
50.—Culvert and quarry pumps.

These comprise the entire charges in connection with the manufacture and the running of the works.

The carbonizing figure alone, which we venture to suggest incorporates more than is commonly included under this heading, stands at 1·303d. per 1000 cubic feet, as compared with the figures given for other works. This figure is so remarkably low that, had it not been the result of a twelve months' working, confirmed by a similar previous period, it might have been received with some measure of doubt as to whether all and sundry items comprised in the running of a gas-works had been duly taken note of. There cannot, however, be any question in this respect, for the statement is supplemented by further statements setting forth clearly all the items of costs associated with the works. The figures relating to the manufacture of carburetted water gas are separately set out, the figures and items enumerated therein relating to the repairs and maintenance of works are given in total, but not sectionized—probably for the reasons stated by Mr. Herring when similar

figures were published last year. The repairs and maintenance of a new gas-works, however, cannot possibly be set forth as an example, or as a basis of comparison with others.

It is a well-understood fact that the wages and expenses in connection with the sale of coke forms an item which is debited to the receipts for coke, and does not appear as a separate record n any published gas-works accounts. It is not perhaps an unheard-of thing for coke to be debited with items that are strictly chargeable to the manufacturing account. In order to show, however, that this has not been done at Granton, Mr. Herring has carefully set forth a list of other items, among which is included the sum spent in manipulating the coke after its delivery from the retort-house. This item we find entitled "Coke Sales, Screening, and Handling;" and as it only amounts to 3d. per ton of coal carbonized, it is quite evident that none of the labour costs involved in other operations can have been debited to this account.

The works, as our readers well know, are exclusively adapted to the inclined-retort system; but seeing that Mr. Herring gets (this is within our knowledge) less than four hours actual work out of the men on the eight-hour shifts, it is quite evident from his figures that, while the system is responsible for a great deal of the economy shown, some measure of economy is also due to the type of works. We find that, apart from the entire charges for carbonizing, from and including the unloading of the coal to the discharge of the coke into the yard, amounting to 1·303d. per 1000 cubic feet, the whole of the remaining expenses associated with the manufacture amount to 0·782d., including the item of general purposes, commonly charged to the repairs and maintenance account in English practice, as follows:—

17.—Lime spreading and slaking.
18.—Oxide charging, discharging, spreading, and turning.
19.—Elevating and conveying.
11. } Exhausters, gas and oxygen, and scrubber-washers.
12. }
21.—Boilermen and trimmers.
26.—Syphonmen.
9.—Heating-up retorts.
20.—Loco. men and shunters (half charged).
22.—Gasholder and pump-house men.
27. } General purposes—viz., office staff, weighers, storekeepers,
28. } messengers, attendants, yard cleaners, &c. (proportion chargeable).
43.—Filling ashes and emptying at refuse-tip.
50.—Culvert and quarry pumps.

It must, therefore, be conceded that type, apart from specific method of carbonizing, must also account for a good deal of the economy that has been achieved, and marks a stage in the history of gas-works design which we are not aware has been so clearly defined before. New works on a more or less large scale have at times been constructed in various parts of the country; but we are not conscious of their efficiency having been subjected to such a test as at Edinburgh.

Analyze the tabular statements in the paper as one will, they must end in an acknowledgment—which it is our pleasure to most cordially make—that the results of the Edinburgh scheme form a unique record, and one that is of considerable interest to everybody associated with the welfare of the gas industry. It is true that Mr. Herring has had a unique opportunity in the inception and the carrying out of his scheme. As we already know, he had a perfectly free hand, and was unhampered by any restrictions imposed upon him by his Board. They received his scheme in the first instance with friendly approval; and although its financial aspects were threshed out, and formed the subject of many special meetings, he was able at all times, by explanatory statements, to carry his views to the issue of reality.

That his judgment in determining the particular type of plant and his skill in designing what was admittedly a new type of work is proved to have been sound, these figures undoubtedly show; and the Commissioners are to be congratulated upon their courage in adopting such a bold scheme of gas-works construction, and have every cause to be satisfied with the financial result of such a policy. Briefly stated, they have constructed entirely new works sufficient in capacity to wipe out three old manufacturing stations, as well as the purchase of a large area of land which will be available for many years to come. The financial burden thus imposed has been met out of the economies produced in the manufacturing costs at the new works, not only comprising the interest and sinking fund charges on the capital involved, but also a self-imposed depreciation fund for the liquidation of the capital of the old works. In addition to this, they have been able to make a present to their consumers of a sum of £23,000 per annum in the form of a reduction in the price of gas below what it ever was before in the history of the undertaking. Such a record is no mean accomplishment, and reflects the highest credit on all concerned—above all, may we not say, upon the designer of the works and the author of the paper, the study of which has revealed so many striking features and lessons.

Sir John Wolfe Barry, F.R.S., K.C.B., has been unanimously elected to succeed the late Mr. J. Mansergh as Chairman of the Engineering Standards Committee of the Institution of Civil Engineers, which post Mr. Mansergh had occupied since the formation of the Committee in 1901.

THE MEETING OF THE SOCIÉTÉ TECHNIQUE.

This year's meeting of the Société Technique du Gaz will be memorable, not so much for any noteworthy addition to our store of technical information, but rather for the generous character of its visits and social functions. Another interesting feature was the number of English people—ten or eleven—participating in the gathering, in addition to whom was M. Brandt, as President of the Belgian Gas Association. This touch of internationality has been more or less in evidence at several of the recent meetings of the Société Technique; and whether it be due in part to the International Gas Congress of 1900 or to other causes, any *rapprochement* with gas engineers of whatever country, but more especially with our friends and neighbours across the Channel, is to be most heartily welcomed. We should like to see the reciprocity which has existed since 1878 in the matter of the elections of the Presidents of the French and English Gas Associations extended to the regular invitation of them, or their representatives, to the annual gatherings of each institution. This procedure would certainly tend to increase still further the opportunities of mutual intercourse and understanding, and strengthen even more the present bonds of fellowship and goodwill.

Such suggestions as these naturally arise after a congress, as at Havre, where the hospitality proffered to the French Society emanated from an English source—the European Gas Company, Limited—whose Chairman, Mr. R. Hesketh Jones, supported by Mr. H. E. Jones, took an active part in the whole of the proceedings. As the report which appears elsewhere shows, this cordiality and generosity on the part of the hosts was characteristic of the congress, and was fully appreciated by the guests. It enabled the Société Technique to further the second of their two great objects—namely, "To keep up relationships, to facilitate the exchange of information and of ideas, and to maintain a spirit of brotherliness between all the members of the Society." Such an aim is far from being by any means the least valuable and the least worthy of any such Society. But it is perhaps the first and main object that has been only partially attained by the Havre meeting, as it was also by that of our own Institution—that is, "To throw light, *by discussion* and by working in common, upon questions relating to the gas industry, to encourage the study of these questions, and to popularize works and discoveries useful to this industry." We have italicized the point to which we wish to draw attention. The fact is that, in spite of a preliminary request to summarize the papers to be read so as to afford more time for their discussion, there is practically no discussion at all, or but very little. Take, for instance, the paper by M. Naudé on the De Brouwer conveyor, which is condensed in another column, and is so bristling with controvertible observations and so provocative of further questions. Yet it passed without a word being said. The paper by MM. Verdier and Teulon on the carbonization of coal, is of quite a different character, and is important and suggestive, though hardly conclusive. But the brief comments or questions of some half-dozen gentlemen cannot be called discussion. In all, there were twenty-four papers, which, with reports, means about 230 pages. Last year there were thirty-three papers, the equivalent of nearly 350 pages. The Institution of Gas Engineers this year had seven papers, or (say) 80 pages; and yet their discussions had to be curtailed. What, then, must it be with three or four times the number of papers? It would seem that our remarks of last week on "The Superabundance of Institution Papers" may be equally applicable to the case of the Société Technique du Gaz. In saying this, we do not forget the essential difference in the constitution of the two bodies, nor the fact that some of the papers presented to the French Society partake almost of the nature of a trade note or novelty announcement. We say this with no disrespect, but to show that in our suggestion for affording means for ampler discussion we have not lost sight of different conditions and points of view.

But though the Société Technique may be parsimonious in technical discussion, they are most certainly not so in the distribution of prizes, which this year have cost £367, being rather less than usual. Further, as M. Visinet reminded us in his interesting and retrospective presidential address, no one has this year sent in an essay for the competition, open to all, for the best thesis on any subject of gas interest, the award for which is 8000 frs., or £320. The Société Technique are also to be complimented, and indeed envied, in another respect. It was in the year 1876 that M. Eugène Lebon, then President, said that if the Society's financial resources were limited to members' subscriptions, the annual receipts would not suffice for the active pursuit of its objects. But, fortunately, a certain number of gas companies and proprietors came to their aid, and now for years past their subsidies had amounted to nearly £1000 per annum. When it is remembered that this large sum is contributed by about fifty Companies, working under limited concessions, one is amazed at the £74 subscribed to the English Institution by some thirty-three gas undertakings; and we wonder what the amount ought to be, so as to compare at all adequately with the French figure. Surely, the £4100 mentioned in Mr. J. W. Helps's report on the establishment of an Investigation Fund does not err on the side of excess.

These are some considerations that occur to us in connection

with this year's meeting of the Société Technique—a meeting combining English hospitality with French courtesy, suggesting different methods of procedure, stimulating financial effort, and generally renewing friendships and giving enjoyment for which we here, to French and English alike, express our very heartiest thanks.

CONCILIATION AND ARBITRATION.

When referring in a recent number of the "Journal" to the latest decision of the Court of Appeal with regard to the now too well-known Denaby and Cadeby Collieries strike, allusion was made to a speech by Mr. Ben Tillett to the members of the Dockers' Union, in the course of which he expressed pleasure at the fact that a spirit of conciliation and arbitration was beginning to be manifested in the matter of industrial disputes. The cordial manner in which the remark was received shows clearly that at any rate the men who were present at this particular gathering are beginning to appreciate the fact that a strike is after all but a barbarous method of settling a question, and one in which the victor frequently suffers as much as, if not more than, the vanquished. We are accustomed nowadays to smile at the ignorance which, centuries ago, was responsible for the institution of the "trial by combat" as a means of setting right a wrong; but after all there does not seem to be any very great difference between the principle which governed this method of procedure and that which applies in the case of a strike. In both instances the victory must be to the strongest and best prepared; but it does not necessarily follow that "might" and "right" are on the same side. It is true that the result of a strike often depends largely on an outside influence—public opinion; but popular feeling is not so invariably the outcome of a sound, well-reasoned judgment as to make it always a desirable element in the settlement of points at issue between master and man. In addition to what has just been said, there are other factors which go to render strikes and lock-outs most unsatisfactory methods in the adjusting of disputes—the grievous, and frequently permanent, loss of trade and the cruel suffering entailed upon women and children, to say nothing of the hardships which the men themselves are sometimes called upon to endure. But if industrial warfare is to cease, it must be displaced by something more effectual and at the same time more reliable in its results. Mr. Ben Tillett, together with many others, has pointed out what this something better is—namely, "conciliation and arbitration." The idea is, of course, not a new one; though its growth has been regrettably slow, in spite of the fact that there are brilliant examples in existence of what can be accomplished in the way of the creation of a friendly feeling between Capital and Labour.

The question of the promotion of industrial peace is one that has been dealt with by various writers from time to time; but we are moved to refer to the subject now by the perusal of a book lately written by Mr. A. C. Pigou, M.A., of Cambridge, in which the author sets himself to consider, not what arbitration and conciliation have done, but rather what they ought to do and how they ought to do it.* The preliminary results of the inquiry were used in an essay which obtained the Adam Smith prize at Cambridge in 1903, and also in a course of lectures delivered at University College, London. But since then the author has carried his analytical work further; and the present book is the result. Our purpose here is not to deal with Mr. Pigou's arguments in detail—or rather with his argument, for the book must be taken as a whole. All we can do is to call attention to the work, so that those interested—not economists only—may procure and study it for themselves. Perhaps the best method of accomplishing this modest task will be by quoting very briefly from the analytical table of contents provided by the author, in which the scope and drift of the argument are made abundantly clear. Mr. Pigou admits that the investigation has proved difficult; that the conclusions offered are tentative and provisional; and that, as for the successful application of general economic principles to the problems of real life, there is needed an experience and knowledge of men with which an academic student can scarcely be equipped, there will probably be defects of detail and errors of proportion. In addition to this, he says, the more theoretical side of the subject has not hitherto been widely discussed; and some of the work to be done was original.

The book is divided into three parts. The first is historical and descriptive; and it deals also with the advantages of industrial peace. In the next are considered the principle of this peace (including full treatment of the question of wages); and in the last part, the methods of securing it. On the latter point, Mr. Pigou argues that peace promoting machinery is of little importance as compared with a friendly spirit; but it is sufficiently important to justify investigation. The interests of industrial peace are forwarded both by treaties made for a period of years between employers and employed, and by the embodiment of these agreements in the organization of *quasi*-permanent Boards. The agreements may assume any of four forms—a rigid determination of wages, some form of scale, an agreement for conciliation and arbitration of whatever differences may arise, and an agreement for conciliation only. Given that the period of agreement is of equal length in each case, a sliding-scale generally gives a better result than a fixed wage if the period extends beyond a year. In all general questions it is desirable, if possible, to settle the difference by conciliation, without resort to arbitration. After dealing with the constitution of Conciliation and Arbitration Boards, the author turns his attention to the problems of mediation and coercive intervention. When mediation is inadequate, he says, the problem of State intervention arises; and on the whole his conclusion, with regard to this country at the present time, is in favour of the promulgation of some scheme for the coercive reference, at the discretion of a Minister, of the differences arising in certain specified industries to a Court whose awards should depend upon the sanction of informed opinion—the institution of a Court endowed with legal powers being debarred by its unpopularity. Mr. Pigou points out that a scheme of the kind he recommends has been favoured in America; and he contends that in England also it lies within the bounds of practical politics.

There are three appendices to the book—the first dealing with the extent to which wage bargains between industrial combinations are indeterminate, the second consisting of diagrammatic treatment of some problems of wage fluctuations, and the third being Mr. Adams's proposed arbitration law. The latter is the American scheme alluded to above, and is a Bill drafted with the object of providing "for the investigation of controversies affecting interstate commerce," and for other purposes. Under its terms, power would be given to the President to inquire (by means of a Commission) into controversies regarding wages, hours of labour, or conditions of employment; the Commission, after full investigation (examining witnesses on oath), would make recommendations, and if necessary suggest legislation; and the President, on receipt of their report, would forward it to the parties involved in the dispute. Of course, this measure was drawn up to apply to one particular branch of business—namely, "interstate commerce"—but it should be equally applicable to other trades, &c.

* "Principles and Methods of Industrial Peace." By A. C. Pigou, M.A. London: Macmillan and Co.; 1905.

Some Modern Gas-Engines.

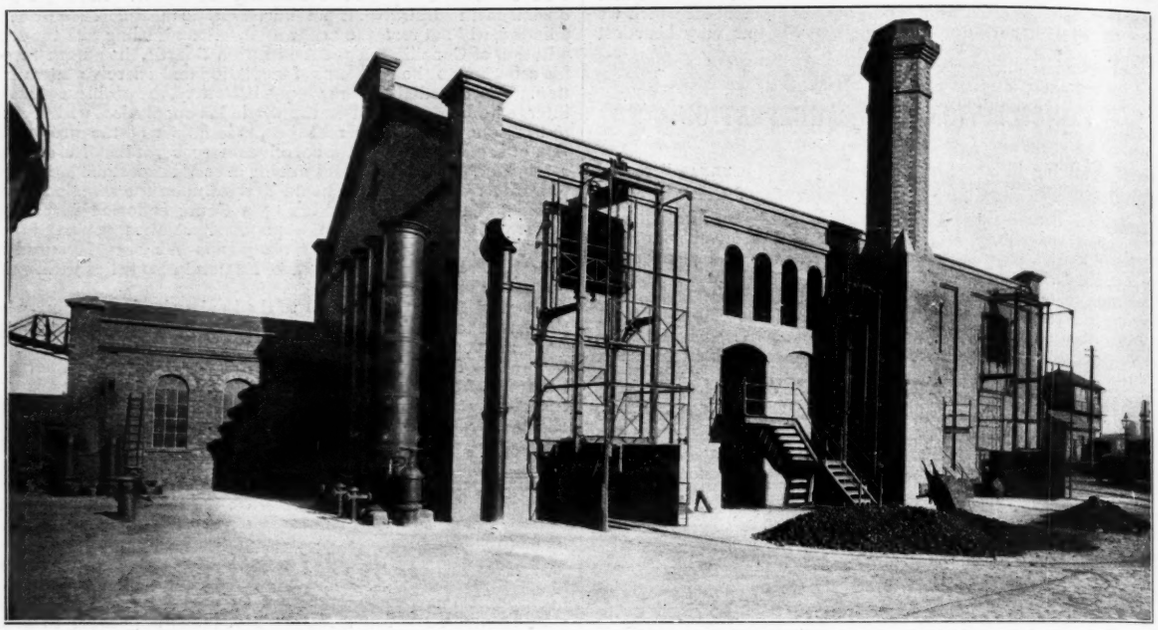
The current number of the "Engineer" contains an illustrated sixteen-page supplement on "Some Modern Gas-Engines;" the subject having been selected because it is one that has of late claimed more than ordinary attention. Our contemporary says that to the remarkable and rapid success of suction gas producers much of this popularity is to be ascribed; but the commencement of the construction of very large engines by British firms, and the frequent discussions on the application of gas power to the propulsion of ships and the generation of electricity, have also to be taken into account. Attention has been confined to engines manufactured in Great Britain, and notice is called to the fact that pioneer work with regard to the larger forms of engine is being done very greatly by firms originally devoted to steam-engine building, and that, with very few exceptions, gas-engine builders are unwilling to launch out into the costly and anxious experiments which the exploration of unknown fields involves—the correctness of which attitude from their own point of view is fully admitted.

The Water Supply of Villages and Small Towns.

There has recently been issued from the offices of the "Local Government Journal," a pamphlet (by Mr. H. C. H. Shenton) bearing the above title. As the Publishers point out, many books have been written by water experts relating to the great water supplies; but few have touched upon the minor places, where it is equally essential there should be pure water obtainable for the villagers. Mr. Shenton has, therefore, rendered good service to the country generally, and to the inhabitants of rural localities in particular, in producing the small book under notice, which shows how sources of water can be best utilized and supplemented for village supplies; also how streams and wells may be kept free from organic pollution. The author explains that he does not pretend to treat the whole subject of water supply; but he claims to have strung together a collection of practical notes which he himself has found useful in the past, and which he believes will be of service to engineers and surveyors having to deal with small water supplies. The book is arranged in numbered paragraphs; and, with the aid of an index, any point can be easily found. The subjects treated of include the tapping of ground by shallow and deep wells, supplies derived from rivers and lakes, from gathering grounds of rainfall, the interception of mountain streams, &c. The best methods of dealing with these matters according to Mr. Shenton's experience are plainly but practically detailed.

As was notified in last week's "Journal," the funeral of Mr. James Mansergh took place on Tuesday; the first part of the service being held at New College Chapel, and the interment taking place in the family grave in Hampstead Cemetery. Among those present were Sir Alexander Binnie, Sir William White, and representatives of Birmingham and Lancaster and of the various Institutions to which the deceased belonged.

NEW COAL-TESTING PLANT FOR THE BIRMINGHAM CORPORATION.

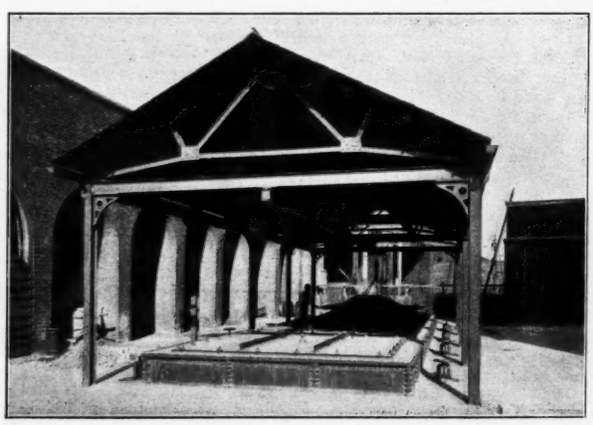


THE EXPERIMENTAL RETORT-HOUSE.

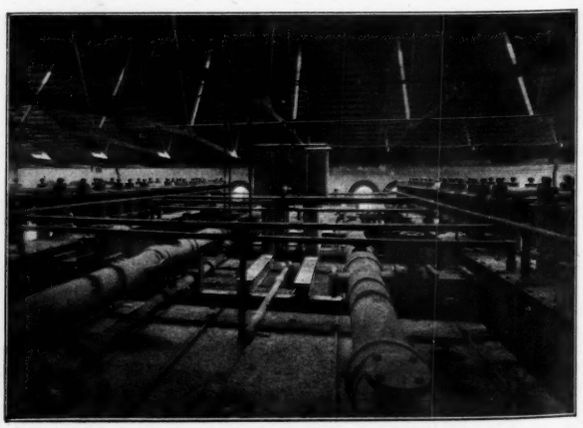
The Birmingham Corporation have recently put into operation a complete coal-testing plant. The contracts for the work were let last year—that for the buildings to Messrs. Whitehouse and Sons, of Birmingham, and that for the gas apparatus, including the retort-bench and chimney, condensers, exhausters, washers, purifiers, gasholder, &c., to Messrs. Robert Dempster and Sons, Limited, of Elland. We give on p. 948 a general plan view of the works, which have been designed to suit a spare corner (bounded by a road, railway, and river) at the Saltley Gas-Works.

The retort-bench, which is on the stage-floor principle, consists of four through arches, each containing settings of six Ω retorts, 21 inches by 15 inches by 20 feet long. The retorts are fixed on Waddell's patent re-generator system, with the furnace on one side of the bench only. There are separate hydraulic mains to each bench, with separate gas and tar outlets—all so arranged that they can be worked either with a seal or by Helps's patent dry-main and tar-tower. There are suitable openings in the stage floor, fitted with shoots for discharging the coke into trucks running on rails on the bottom floor. The coal is brought to the site in narrow-gauge side-tipping trucks, which are elevated into the coal-stores at each side of the retort-house (the coal-stores being a series of bins with brick division walls) by means of hydraulic hoists; the power being obtained from the existing accumulators. The total length of the retort-house — including coal-stores — is 87 feet, and the span of the roof 47 feet.

THE STAGE-FLOOR OF THE RETORT-HOUSE.



THE PURIFIER SHED.



THE HYDRAULIC MAINS AND PIPE CONNECTIONS.

Suitable staircases are provided for giving access to the retort-house floor. The foul main is 16 inches in diameter, and made of mild-steel plates.

The annular condensers consist of four columns, each 19 feet high, with outer tubes 32 inches in diameter and inner tubes 22 inches in diameter, fitted with wing-valves for regulating the current of air, and also fitted with a bye-pass. There is also a water condenser 10 ft. 6 in. high, 3 ft. 6 in. wide, and 5 ft. 3 in. long, divided in the centre into two compartments filled with steel tubes ¾-inch diameter. The water circulates inside the tubes, which are surrounded by the gas.

In the exhauster-house there are two rotary exhausters, each of 10,000 cubic feet capacity per hour. These are driven by means of cone-pulleys off a countershaft driven by gas-engines, two in number. One engine, as well as one exhauster, always acts as a standby. Off the countershaft are also driven two pumps, one for tar and one for liquor.

The Livesey washer is of 250,000 cubic feet capacity per day, and of the usual type. The rotary scrubber-washer (Messrs. W. C. Holmes and Co.'s make) is driven by means of a chain off the exhauster countershaft.

THE WADDELL'S PATENT REGENERATOR FURNACES.

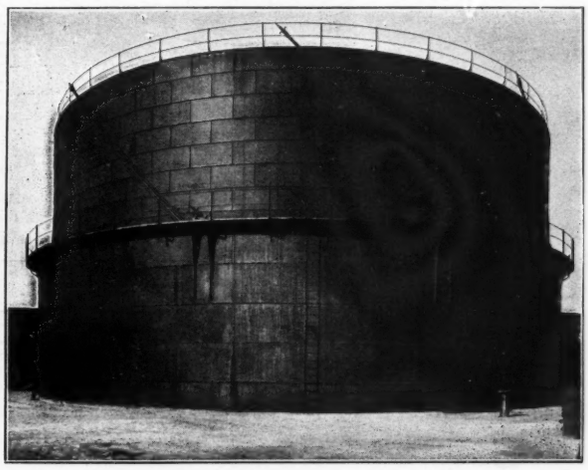
The purifiers are four in number, 14 feet square by 5 feet deep. They are continuous, and on the Green's system; the size of the cover opening being 11 ft. 6 in. square. The purifiers are worked by means of Hack's disc-valves. There is a light roof, to which the lifting apparatus is attached, covering the purifiers.

The gasholder is on the spiral-guided system in a steel tank, 84 feet diameter by 25 ft. 6 in. deep. The outer lift of the holder is 82 feet in diameter by 25 feet deep; the inner lift, 80 feet in diameter by 25 feet deep. It is fitted with Dempster's patent diagonal plates, to which the rails are secured. The steel tank was riveted *in situ* by hydraulic riveters.

The whole of the work was carried out in accordance with the general plans prepared by Mr. Henry Hack, the Engineer-in-Chief of the Birmingham Corporation Gas Department, and under his supervision.

The works are capable of producing 250,000 cubic feet of gas per 24 hours; and the object of the works is to enable the officials to test on a manufacturing scale all coals and cannels which have been supplied to the Department in the past, or which may be offered to them in the future. The tests hitherto made have been limited to ½ cwt. charges carbonized in iron retorts. The tests will in future include the quantity and quality of the gas made, the yield of ammoniacal liquor and tar, the impurities (including sulphur) in the crude and purified gases, the illuminating power, the calorific value, and the composition of the gas produced, the ash and sulphur in the coke—in fact, the fullest information on all the materials dealt with. The test will be made for all the foregoing particulars from the same coals, under high, low, and intermediate temperatures of carbonization and fuel used, "per ton of coal carbonized in each case."

THE EXHAUSTER-HOUSE.



THE SPIRAL GUIDED GASHOLDER.

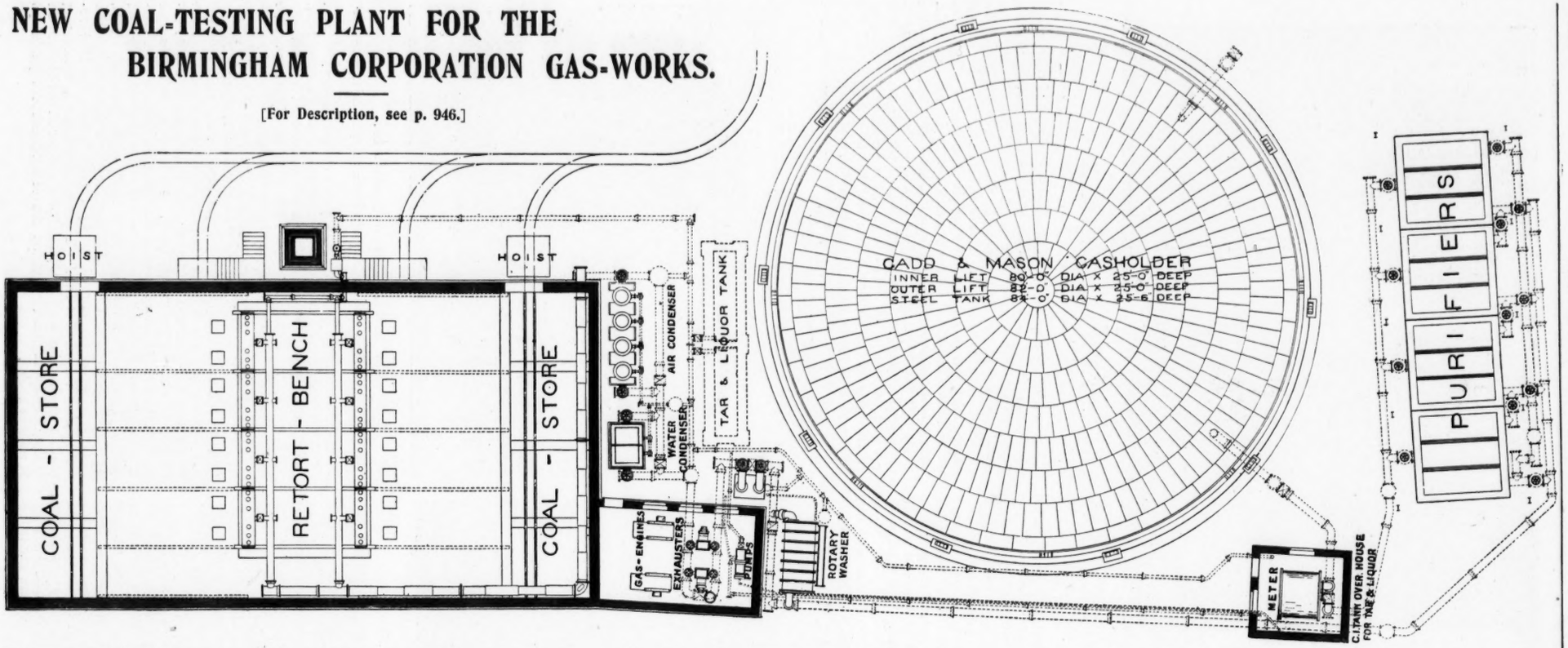
Synthesis of Formaldehyde.—At a recent meeting of the Chemical Society, this subject was dealt with by Mr. D. L. Chapman and Mr. A. Holt, jun. The authors have succeeded in synthesizing formaldehyde by maintaining a platinum wire at a high temperature in the following mixtures: (*a*) Carbon monoxide and hydrogen; (*b*) carbon monoxide, hydrogen, and steam; (*c*) carbon monoxide and steam; and (*d*) carbon dioxide and hydrogen. All attempts to obtain formaldehyde in appreciable quantities by passing the same gaseous mixtures through heated tubes at temperatures below 500° C. were unsuccessful.

Artificial Fertilizers.—According to the "Times of India," the Inspector-General of Agriculture in India has addressed all local Directors of Agriculture, making suggestions for experiments in manuring cotton. The proposal is to ascertain, at the various experimental stations, the most suitable form of manure for each class of soil, and the best way of applying it. Superphosphates and sulphate of ammonia and other artificial fertilizers are to be tried as well as natural aids. The Canadian Commercial Agent at Melbourne reports that artificial fertilizers have had a very large sale in Australia during the past year. Farmers are using them in increasing quantity. They are largely imported from Great Britain, though considerable quantities have recently been sent from Japan. About one-third of the amount required is made locally; and as farmers are finding the locally-made article most satisfactory, they are giving it preference.

Train Lighting.—The opening lines of an article on "A New Train Lighting Dynamo" in the "Electrician" this week are as follows: "Though numerous attempts have been made to solve the problem of train lighting, there does not yet exist a system which can be described as satisfactory both with regard to reliability of working and initial costs. The reason for this seems to be that most inventors have an idea that the voltage of a continuous current dynamo must necessarily vary in proportion to its speed. That it is not the case has recently been shown by Dr. E. Rosenberg, Scientific Adviser and Chief Engineer to the Allgemeine Elektricitäts-Gesellschaft, in a paper read before the Elektrotechnischer Verein of Berlin." The first statement is interesting read in conjunction with Mr. E. C. Riley's paper at the Institution of Gas Engineers' meeting on the use of incandescent gas-lamps in railway trains.

NEW COAL-TESTING PLANT FOR THE BIRMINGHAM CORPORATION GAS-WORKS.

[For Description, see p. 946.]



EXAMINATIONS IN "GAS MANUFACTURE" AND "COAL TAR."

Official Programme for Next Session.

Among the books which are always in demand by those who are engaged in studying for the gas profession, the programme of the technological examinations of the City and Guilds of London Institute takes a foremost place; and we therefore hasten to inform readers that the issue for the session 1905-6 has just been published. If students who contemplate offering themselves for the examinations in "Gas Manufacture" or "Coal Tar Distillation and Coal Tar Products," will note that the programme is to be obtained from Mr. John Murray, of Albemarle Street, W. (price 9d. net, or 1s. post free), they will be able to save themselves the trouble of writing to the "Journal" office later on for the address at which copies can be secured.

The next examination in "Gas Manufacture," it may be mentioned, will take place on Saturday afternoon, April 28, from 2.30 to 6.30; the Acting Examiner being Mr. A. F. Browne, of Vauxhall (who takes the place of Dr. Harold G. Colman), and the Consultative Examiners, Messrs. Robert Morton and Charles Hunt. The examination on "Coal Tar Distillation and Coal Tar Products" is fixed for Thursday, May 3, from 7 to 10 p.m.; the Acting Examiner in this instance being Professor A. G. Green, and the Consultative Examiner Dr. W. H. Perkin. March 19 is the last day for receiving from Local Secretaries applications and fees for technological examinations. The fee for either grade of the examination in "Gas Manufacture" is 1s. 6d.; while that on "Coal Tar" is divided into two sections—"Distillation" and "Products"—the fee being 1s. 6d. for either grade of either section. Certificates are awarded on the results in both of the grades of these examinations; but there are some special conditions attaching to the granting of the full technological certificate.

The following prizes are (as usual) offered by the Salters' Company: "Gas Manufacture:" Honours grade, (1) £2 and Institute's silver medal; (2) £2 and a bronze medal. Ordinary grade, (1) £1 and Institute's silver medal; (2) £1 and a bronze medal; (3) bronze medal. "Coal Tar Products:" Honours grade, £2 and the Institute's silver medal. Ordinary grade, (1) £1 and the Institute's silver medal; (2) £1 and a bronze medal; (3) bronze medal. As usual, the programme contains lists of books which will be of assistance to students in the different subjects covered by the examinations; and a list of persons registered as qualified teachers in technology is also included.

Those who intend submitting themselves for examination will, of course, take careful note of the syllabus. For convenience, we reproduce on p. 978 of to-day's issue the list of subjects named by the Institute as an indication of those on which questions in "Gas Manufacture" will be included; and it may be pointed out that the actual questions set in this year's examination were given in the "Journal" for May 9 (p. 380.)

INCANDESCENT MANTLE TOPICS IN AMERICA.

CHATTING over incandescent mantle matters, we have been informed that there have lately been certain changes in the situation in America. Several of the smaller mantle manufacturers—notably the American Incandescent Light Company, the "Challenge" Company, the "Raritan" Company, together with some New York jobbers (the most important of whom are Messrs. Schaffer and Co.)—have amalgamated, and formed what is named the United States Mantle Company, with a capital of $2,500,000, or approximately £500,000. There is an interesting development worth recording in the operations of this among other concerns. They are now manufacturing mantles by means of what is known as the Robin machine. This is a machine that is at the present time being employed by the German Welsbach Company and by Messrs. Richard Feuer and Co. in Berlin. It is said that there is some connection between the German Welsbach Company and the United States Mantle Company. However, the machine in question is capable of making some 4500 mantles in ten hours; and the saving effected is estimated at between 2s. and 4s. per 1000 mantles. The machine performs all the operations to the completion of the mantle after the impregnation of the fabric. The impregnated stockings are placed on the machine, passing first to a series of gas-burners which incinerates the cotton or ramie base, and then to the high-pressure gas-burners for the shaping and tempering of the mantles. Travelling onwards to another portion of the machine, the mantles are collodionized, then raised to the top of the machine where they are caused to pass through the hot currents ascending from the burners, and in this way are dried. Finally, they pass to the cutter, which is part of the same machine. The machine is also used by a number of other American manufacturers. Its main commendation, it is reported, is its ability to produce uniformity of the finished mantles; the saving effected being a secondary consideration. Each machine is fed with ten to twelve mantles at a time; but on one machine there may be as many as 200 mantles in the various stages leading to completion. The work is therefore continuous; and yet each machine for its several operations only requires three attendants.

Our informant proceeded to speak of the position of thorium; and, while he said there had been no very definite change in the situation, his intimate knowledge of the matter enabled him to assert that the position is, if anything, tighter. There is no doubt that the question is "an actual and acute one." The rumour, he added, has gone round that the price of thorium is going to be advanced. He thinks credence may be given to this, seeing that the situation is so absolutely controlled by but a few men, with little monazite in sight, and there is nothing to prevent them increasing the price if they are so minded. He speaks highly of the North Carolina monazite fields. The quality of the thorium now being produced in the States, he declares, is in many respects equal to that imported, and generally considered to be better; and it sells at an even price with the imported Brazilian article. It is now "an open question whether there is not really more of it controlled by the Welsbach Company and the National Light and Thorium Company than there is in Brazil, seeing that the Brazilian deposits have been so heavily drawn upon during the last eight or ten years." However, that is a statement on which we have not at present any confirmatory evidence; and it will be noticed that our visitor uses the expression "open question." He is able to speak more positively as to the consumption of thorium being decidedly increasing in America. Throughout last year the business was very good; and the volume of trade this year up to the present time has been probably from 20 to 30 per cent. larger than during the corresponding period of last year. Generally speaking, the use of the incandescent gas-burner has not had the universality in the States that it has had on the Continent; but America is now making up for lost time.

Some interesting information was also afforded by our visitor as to the financial position of the American Welsbach Company and the ramifications of the concern. Regarding its capital he said that it consisted of $7,200,000 in 5 per cent. debentures, and $3,750,000 in ordinary shares. The sinking fund requirement is $105,000 a year, which is about equal to £21,000. The interest and sinking fund on the debentures is therefore equal to $465,000 a year. The net earnings last year were $547,000, which allowed something for the common stock. Originally the Company had a capital of $525,000 in $5 shares. Those shares sold at one time at 50c. (2s.) per share; and they then advanced to $95. Then the Welsbach Commercial Company was formed to exploit the rights; and it was capitalized at $7,500,000—$3,750,000 preferred shares, and $3,750,000 ordinary shares, with about $500,000 in cash. This Company and the Welsbach Company were subsequently amalgamated—the present Company being thus established. For the preferred shares of the Welsbach Commercial Company, 5 per cent. debentures were given; and the Welsbach Light Company were also absorbed on the basis of 5 per cent. debentures—$40 being given for each $5 share. So out of probably $500,000 actually invested in the business in the first instance, has grown, says our visitor, the present American Welsbach Company. There is another corporation known as the Welsbach Street Lighting Company, which is wholly independent, but the capital of which is said to be held by some prominent stockholders of the American Welsbach Company. The net earnings of this concern last year were nearly $600,000. Then there is a Corporation (controlling the Welsbach part of the Carolina monazite sand property), known as the Carolina Monazite Company—in which the American Welsbach Company hold a controlling interest—with a capital of $500,000 (£100,000). The United Gas Improvement Company, control all these businesses, seeing that they own a predominating interest in the stock, bonds, and debentures of the American Welsbach Company. The output of the American Welsbach Company is something like 20 millions of mantles a year; and the output of the independent concerns is in excess of 30 millions a year—the estimated present consumption of mantles in North America being between 50 and 60 millions a year. There is a strong tendency, however, towards the amalgamation of the outside interests; and present indications are that the close of the year will see only two or three major organizations engaged in the manufacture of mantles.

Among other interesting points in the conversation, it was elicited that the inverted incandescent burner has "taken on" in America; and is now being adopted in the railway cars.

THE GOVERNMENT AND THE UNEMPLOYED.

IT has been computed that, assuming Parliament to be prorogued at the usual time—namely, at or about Aug. 12—there remain only seventeen clear days for the passing of the Bills promised by the Government at the beginning of the session—not one of which has yet got through the Committee stage. Even the Unemployed Workmen Bill, which was set down in the King's Speech as of urgent importance, was not read a second time until a few days ago, when it was passed by a huge majority. In explaining its provisions, Mr. Gerald Balfour pointed out that these do not pretend to deal with more than a part of what is known as the "unemployed question;" the object being to assist only a limited class of the unemployed, defined in the Bill as "honestly desirous of obtaining work but temporarily unable to do so from exceptional causes over which the applicant has no control"—much limitation being, however, extended to cases which, in the opinion of the local body to whom application is made, are "capable of more suitable treatment under this Act than under the Poor Law." The intention, consequently, is to exclude loafers, casual workers, intermittent workers whose case was not exceptional, and any man out of work from fault of his own. Under the rules, moreover, which are to be inserted in the Bill for the guidance of Local and Central Committees, distress not due to lack of employment, chronic distress, applicants of bad character, or not complying with conditions of residence, would be excluded from its operations; while preference would be given to workmen with wives and families. It is provided also that "the total weekly remuneration given for any temporary work shall be less than that which would under ordinary circumstances be earned by an unskilled labourer for a full week's work;" and also that "except with the consent of the Local Government Board, temporary work shall not be so provided for the same person in more than two successive years."

It is clear from this that while the whole aim of the Government measure is to make some provision for respectable workmen settled in a locality, accustomed to regular work but temporarily out of employment through circumstances beyond their control, it is not intended to give such assistance as might render applicants independent of ordinary and regular employment. Thus an entirely praiseworthy object is sought to be accomplished in a way to which but little real objection can be taken. There are no persons, in unfortunate circumstances, more deserving of sympathy and assistance than those who are suffering from want of work through no fault of their own. At the same time, it is very evident that the usefulness of the machinery which the Bill would set in motion, must depend entirely upon the discrimination by which it is controlled. The distribution of funds raised voluntarily for the relief of the unemployed has generally left a great deal to be desired; and much will have been accomplished if an improvement be effected in this respect, and assistance with the minimum of burden to the State be given to the really deserving. None the less, the Bill introduces an entirely new principle into legislation, by providing that governing bodies are to be responsible for securing employment for those who are not able to find it for themselves. The Bill, moreover, for the first time gives statutory recognition to a system of relief unencumbered by the disability which attaches to Poor Law administration. It provides also for the creation and maintenance of machinery for organizing employment, and, to a limited extent, affords relief at the expense of the rates—such machinery to be outside and altogether independent of the Poor Law. It may be pointed out, however, that these innovations are after all more apparent than real, since for many years past local authorities have been giving employment relief at the expense of the rates. There is no use in disguising this fact—employment relief as doled out by local authorities spasmodically, and without adequate preparation, during the occasional periods when ordinary work has been scarce, has been far from remunerative to the ratepayer; while the desultory way in which it has been given has greatly militated against its usefulness. In one case quoted by Mr. Balfour, the greater proportion of those on the list of unemployed last winter only received four days' work between Nov. 16 and Jan. 21; and this, at 3s. 4d. per

day, averaged but 1s. 2d. a week for the whole eleven weeks. In many other instances it was usual for the unemployed to obtain relief for only two or three days, or for them to be given in turn three or four days, with the prospect of waiting for further work until their turn came round again. It is one of the objects of the Bill to provide work of a more constant character than this; and for this purpose not only is migration and emigration to be encouraged, but the acquiring, equipping, and maintaining of farm colonies, and providing for work for the unemployed on these colonies. The latter seems to be suggestive of constant employment being found for those who are temporarily unemployed, because it is not to be assumed that the farms when once in hand will ever be allowed to become derelict during periods of prosperity when ordinary employment becomes plentiful. The suggested establishment of labour bureaus and employment registries all over the country is a good idea, and ought to be productive of important results.

On the whole, there seems to be no reason why a scheme of this description should not be very beneficial not only to the class for whom it is intended, but also to the country at large. The ruling idea is to systematize and divert into remunerative channels labour which at the present time mostly runs to waste, or to which employment is given in such a form as tends to pauperize the individual. This was always one of the worst features of the existing system, or want of system; and if the present proposals should lead to the provision of relief to the deserving unemployed without involving loss of self-respect, they cannot but be advantageous to the State. It was not, of course, to be expected that such a measure as this should meet with universal approval. Steering a middle course (as this Bill does) is certain to be objected to by extremists on both sides; and while the rejection of the Bill is to be ardently desired by those who, like Sir George Bartley, regard it as dangerous to the welfare of the country, and detrimental to the interests of the class it is intended to benefit, those who more nearly represent that class are anxious to secure a wider scope for it. At a conference recently held of Trade Union representatives and the labour members of the House of Commons, it was decided to propose amendments the object of which will be to make the measure compulsory and uniform over the entire kingdom, each county becoming an administrative unit, and the councils of county and other boroughs and those of urban and rural districts local authorities only. It is also proposed to make the London area that of the Metropolitan Police district, instead of the London County Council. Meanwhile, in spite of the very large majority by which the second reading was carried, considerable lukewarmness towards the Bill is being manifested; and this seems not unlikely to delay its further progress.

A JUNIOR ASSOCIATION AND TECHNICAL CLASSES FOR THE MIDLANDS.

The Hon. Secretary of the Midland Association (Mr. Charles Meiklejohn, of Rugby) is actively pursuing the proposal to form a Junior Gas Association for the Midland Counties—a matter which was under the consideration of the Senior Association at their meeting at Leamington on the 18th ult. But the scheme does not contemplate stopping at the formation of a junior organization, but takes within its scope the establishment of classes or lectures on "Gas Manufacture" in connection with the Birmingham Technical School.

In regard to the Junior Association, Mr. Meiklejohn has issued a circular to the members of the senior organization, inviting their co-operation in securing the attendance of as many of their junior works' staff who would join such an Association and take an interest in its work, at a meeting to be held next Saturday, at 3.30 p.m., in the Council Room of the Birmingham and Midland Institute. The letter says: "The objects of the Junior Gas Association will be the reading of papers, visiting gas and other engineering works, and promoting generally the advancement of the gas industry. The suggested annual subscription is 5s. It is to be constituted and officered by the juniors themselves."

Concerning the establishment of classes or lectures on "Gas Manufacture" at the Birmingham Technical School, Mr. Meiklejohn addresses the members as follows:—

As reported to the general meeting of the members at Leamington, the Committee of the Association are desirous of establishing classes or lectures on "Gas Manufacture," in connection with the Birmingham Technical School. The Principal of the School, Dr. Sumpner, has already expressed his sympathy with the proposal, and will be glad to arrange a meeting between the Committee of the Association and the Council of the Technical School, with whom rests the final decision in the matter.

To strengthen the hands of the Committee, will you be good enough to inform me—1. How many in your works or office would be willing and able to attend such lectures, to be held in Birmingham, during the winter session (say from September to April) one evening per week? 2. Would you be willing to grant facilities to the teacher or lecturer appointed to give (after due notice) an occasional practical demonstration in your works or laboratory to the members of his class?

As the number of students likely to avail themselves of the opportunities for technical instruction which the Council of the Technical School may provide will, in all probability, determine whether the Council will feel justified in incurring the necessary expense of providing a teacher, &c., it is obvious that the greater the number of possible students the more likely it is that the Council will favourably consider the proposal to place "Gas Manufacture" in the School Syllabus.

It is, however, of the utmost importance that only the names of those who mean to pursue the subject in earnest, and who mean to attend the lectures throughout the session, should be given as "possible students," as otherwise the Committee of the Association might be led to approach the Council of the Technical School with numbers which might induce them to grant our request only to find before the session was completed that these numbers had dwindled to insignificant proportions.

The importance of the gas industry locally and the enormous amount of capital involved in it, justify the hope that the Council will favourably entertain the proposal to further the technical education of those engaged therein.

It remains for us to convince the Council that a sufficient number of students will avail themselves of the opportunity for technical instruction, which we propose asking them to provide, to secure the success of the scheme.

Mr. Meiklejohn desires the earnest help and co-operation of the members in these matters; and we sincerely hope he will receive it, and that promptly. Both projects are worthy of the utmost sympathy and encouragement.

OFFICIAL REPORT ON THE GAS EXHIBITION.

Six months after the close of the International Gas Exhibition at Earl's Court, we have received the report of the Exhibition Advisory Committee of the Institution of Gas Engineers. It is in the form of a neatly bound and well-printed volume of some 154 pages, including the index; and as a compendious history of the whole exhibition from its inception to close, it will serve as a useful memento, though we are vain enough to think that those who require a more detailed account of what led up to the exhibition, and of the proceedings and displays of apparatus and appliances thereat, will consult the literature published in the Technical Press contemporaneously with the exhibition itself.

The report of the Committee which opens the volume is largely composed of the preliminary circular-letters issued by them; and these will be valuable as, if nothing more, exemplars when the time comes for the holding of another exhibition of similar character. Following copies of the appeals made for funds, we have a list of the Companies and Gas Committees of Local Authorities who subscribed to the special fund raised. In all, it is seen there were 176 subscribing companies or committees, but the latter were comparatively few, though those contributing did so handsomely. Among the Companies, the Gaslight and Coke Company headed the list with £100. The total amount subscribed was £1412 11s. The special functions associated with the exhibition, the memories of which are of the most pleasant, are noticed; and among them reference is made to the reception of "American and Continental Visitors" at the exhibition on Dec. 6. It is, however observed, that the list of delegates mentioned are all from the Continent; and no one from America is named as having been present at the reception. The special attractions and entertainments provided by the Advisory Committee receive due notice; and succeeding this section come references to the "Novelty Section," which was the only disappointing feature of the whole exhibition. The offer of awards for approved novelties and drawings in respect of fittings and lamp-posts met with a response which, in the words of the report "can only truthfully be described as meagre. . . The exhibits in the section failed, as a whole, to support the notion of the existence, outside the regular trade sources of such articles, of any notable reserve of artistic talent or craftsmanship."

The "Appendix" to the report consists of an account of the exhibits; and it is somewhat disappointing. The opportunity was an excellent one for the Committee to have marked "the time o' day" by pointing out which of the exhibits (at the same time describing them) represent the most modern advances in each department of the gas industry. This they have not done. Therefore, as an historical report and as a representation of the progress indicated by the exhibition, its value is much depreciated; and in years to come, inquirers who may turn to the "official" report hopeful of finding a fairly complete description of the newest of the apparatus and appliances exhibited in 1904, will be disappointed. It is true the Committee acknowledge that the account they give of the exhibits is a "condensed" one. They say, in a short preface to the "Appendix:"

With a view to making their own report of the actual exhibits as faithful and just to the exhibitors as possible, invitations were issued to all stallholders asking them to supply particulars of their exhibits for use in the compilation of the "Official Report." From the returns to this inquiry, and where these were lacking or insufficient, from the catalogue (to which many exhibitors referred), the following subject-matter index and condensed description of the contents of the Exhibition have been prepared. The Committee have not deemed it expedient to reproduce lengthy particulars nor illustrations of trade articles familiar in the contemporary technic; nor are they responsible as a body for the statements supplied by exhibitors.

That is the apology for brevity and deficiency. Our criticism amounts to this, that while the report, it is freely admitted, is good so far as it goes, as an "official" report it does not go nearly far enough, and falls considerably short of expectations. But for this, as is seen by the extract made above, the Advisory Committee as a body make themselves fully responsible.

SOCIÉTÉ TECHNIQUE DE L'INDUSTRIE DU GAZ EN FRANCE.

THE THIRTY-SECOND ANNUAL CONGRESS—HAVRE, JUNE 20 to 23.

REVIEW OF THE PROCEEDINGS.

The Thirty-Second Annual Congress of the Société Technique de l'Industrie du Gaz en France was opened last Tuesday morning in the Council Chamber of the Hôtel de Ville at Havre. The PRESIDENT (M. Georges Visinet, the General Manager of the St. Germain Gas Company), took the chair shortly after half-past nine, by which time there was a very good muster of members, upwards of 200 being present. On the platform, to the left of the President, sat the Secretary (M. Payet); and on his left, Mr. J. W. Helps, of Croydon, occupied a seat. Among those who had signed the attendance-sheet were Mr. H. E. Jones, the Deputy-Chairman of the European Gas Company, Mr. W. Williams, the General Manager, Mr. W. B. Brady, the Assistant-Secretary, M. Gaston Gautier, the Company's Engineer at Havre, his brother, M. Gustave Gautier, who occupies a similar position at Rouen, and MM. Coudelon (Caen), Cros (Amiens), Marchal (Nantes), and Peschot (Bolbec), their colleagues. The attendance-sheet also contained the name of Mr. R. S. Gardiner, formerly Secretary of the Imperial Continental Gas Association, as well as those of several members of the gas profession which have become familiar to readers of the "JOURNAL" in connection with their contributions to the Society's proceedings.

The first item on the *agenda* was the election of the new members proposed. At the head of the list distributed among the members stood the name of Mr. Daniel Irving, M.Inst.C.E., in his capacity of President for the year 1894-5 of the Institution of Gas Engineers. Then followed the names of 31 ordinary and five associate members—among the former being Mr. R. W. Wilson, the Secretary, and Mr. H. F. Andresen, an Assistant-Secretary, of the above-named Association. On the morning of the meeting the names of two additional ordinary members and of one associate member were submitted, making 33 of the former and six of the latter; and these gentlemen were all admitted to membership of the Society.

COMMITTEE'S REPORT.

The report of the Committee was then read by the President. The first portion of it was devoted to notices of the members who had been removed by death during the year. Special mention was made of Mr. Edward Drory, whose decease, the Committee said, not only came as a melancholy surprise to his friends, but would be regretted in the gas engineering world at large, by which he was justly regarded as one of its most eminent representatives; of M. Jouanne, the Technical Editor of our contemporary "Le Gaz," as well as of the companion publication, "Le Constructeur d'Usines à Gaz," whose rare qualities of mind and heart had gained for him many friends, by whom his loss would be keenly felt; of M. Alexandre Lencauchez, whose name is well known all over the Continent, as well as in England, in connection with his system of retort setting and heating; and of M. Vacher, whose death within a few days of the meeting removed one of the founders of the Society, and the Manager for many years of the European Gas Company's station at Amiens, relinquishing the position about three years ago.* A few members left the Society during the year; and at the close the roll stood as follows: Honorary members, 22; ordinary members, 518; associate members, 112—total, 652, an increase of 12 compared with the year 1903. In their closing remarks the Committee referred to the International Exhibition at Earl's Court, of which the President was one of the Vice-Presidents. All the members of the Society were invited by the Institution of Gas Engineers to visit the exhibition, and to enjoy the hospitality which would be accorded to them. For the benefit of those who were unable to do this, a report on the exhibition had been prepared by the Secretary of the Society (M. Payet),† and it would inform the absent members, and serve as a reminder to others, of the great interest presented by the undertaking organized by the Institution of Gas Engineers, and of the warm welcome which the representatives of the Society received from their English colleagues. The Committee then passed on to acknowledge subscriptions to the funds of the Society to the total amount of 24,625 frs. (£985), ranging from 2400 frs. down to 50 frs., from gas and other companies. The list included several new donations. In conclusion, the Committee informed the members that the year had presented a touching instance of the interest taken in the Society, by the presentation thereto, by Madame Paul Durand, as a *souvenir* of the late much-regretted M. Gustave Jouanne, of a complete collection of "Le Constructeur d'Usines à Gaz." Its collection of 960 plates, in 20 volumes, represents an interesting record of the progress made in, and of the various inventions connected with the improvement of, gas-manufacturing plant and the construction and general arrangement of gas-works. In accordance with the intentions of the donor, this important work will be offered as a prize for the current year, under conditions to be subsequently made known to the members. The Committee have expressed their sincere thanks to Madame Durand for her valuable and useful gift.

* The funeral took place at Amiens on the 15th inst., and was attended, on behalf of the Company, by the Assistant-Secretary (Mr. Brady), and by M. Gustave Gautier and M. Cros, the Managers of their Rouen and Amiens stations. The interment took place at the Cemetery of La Madeleine, where Mr. Brady paid fitting tribute to the service rendered to the Company by the deceased, and expressed their sorrow at his loss and their sympathy with his widow and family in their bereavement.

† The report referred to was noticed in the "JOURNAL" for the 13th inst.

FINANCIAL POSITION OF THE SOCIETY.

The report presented by the Treasurer, and read in his absence by the Secretary, showed that the expenses for the year amounted to 46,750 frs., and that a sum of 353 frs. had been spent this year; making together 47,103 frs. (£1884). The revenue having been 50,420 frs. (£2017), there was an excess of 3317 frs. (£133). The largest items of expenditure are those for publications, 12,484 frs. (£499); and prizes, 9181 frs. (£367). The capital of the Society, which amounted to 195,824 frs. (£7833) on Dec. 31, 1903, stood at 197,761 frs. (£7910) at the close of the past year—an increase of 1937 frs., or £77. The report was adopted without remark.

RECONSTITUTION OF COMMITTEE AND ELECTION OF OFFICE BEARERS.

The members then proceeded to ballot for the reconstitution of the Committee, with the result that MM. Bigeard, Gardiner, Godinet, Thibaudet, Bouvier, and Kaeuffer were elected. The announcement of the result closed the morning sitting.

There was a much more numerous attendance in the afternoon, when the meeting was honoured by the presence of the Sub-Prefect (M. Piette), the Mayor of Havre (M. Maillart), and the Deputy-Mayor (M. Le Blond), who occupied seats on the platform. The Chairman of the European Gas Company (Mr. R. Hesketh Jones) and Mr. H. E. Jones were also present.

The first business was the announcement of the result of the meeting held by the Committee for the selection of the office-bearers for the current year. It was as follows: President, M. Visinet (re-elected); Vice-President, M. André Coze; Secretaries, MM. Thibaudet and Godinet; Treasurer, M. Marquisan.

PRESIDENT'S ADDRESS.

The President thanked the officials of the town for the interest they had shown, as testified by their presence at the meeting, in the work of the Society, and then proceeded to deliver his Inaugural Address. He began by referring to the "great event" that the year 1905 would see—namely, the expiration, on Dec. 31, of the Paris Gas Company's concession with the city, which had lasted since 1855. No one could as yet foretell the precise result. The Société Technique had always had friendly relationships with the Compagnie Parisienne du Gaz, whose works had always been thrown open for visits. It was to be hoped that, whatever the consequences of the termination of the present concession might be, it would not give rise in the gas industry of France to any increased difficulties, which, however, could be overcome by energy, patience, and work. After brief reference to the Earl's Court Gas Exhibition, and to the present trend of gas manufacturing methods, the President remarked that his nomination to that office coincided with the thirtieth anniversary of the foundation of the Société Technique, which dates from March 5, 1874; the first general meeting with 84 members taking place on the 23rd of June following, under the presidency of M. Mallet. It was not unfitting, therefore, to glance over the past years, to call to mind the work done, and to show that the intentions with which the Society started had been fully realized.

At this first meeting, M. Foucart read a paper giving a translation of Mr. John West's patent for stoking machinery, and M. Ellissen described the work of Clegg, Mann, Foulis, and others. Now, thirty years later, the topic of charging and discharging machines was still a very living and important one. At the 1875 meeting at Lyons, M. Emile Vautier was President, and gave an account of the Bordeaux works, the concession with which town had then been renewed, as it has been once again just recently. The following year, 1876, M. Eugène Lebon presided at Rouen, and was able to congratulate the members on the result of an appeal to gas companies for funds to enable the Society to carry on its work; the amount for the year 1877 being 10,295 frs., or about £412. Gas was refused a place at the "Exposition Universelle" of 1878—an effective contrast to the happy result of the Exhibition of 1900. At the Paris meeting in 1878, says M. Visinet, "the Société Technique received a valuable mark of sympathy from the British Association of Gas Managers. The then President of the Société Technique and the Past-Presidents were made honorary members of the great English Association. It is from that time that, by a very natural reciprocity, the Presidents and Past-Presidents of the English

Institution are made honorary members of our Société Technique." In 1882, M. Foucart succeeded in getting subscriptions for a statue to Philippe Lebon at Chaumont. The average consumption of gas yearly per inhabitant was given by M. Ancel, at the Marseilles Congress in 1883, as being for London, 139 c.m. (4910 cubic feet); for Paris, 99 c.m. (3496 feet); and for Lyons, 62 c.m. (2190 feet). It was in 1885, at the Bordeaux meeting under the presidency of M. Breitmayer, that M. André Coze read his first paper on inclined retorts. From Boulogne, in 1888, when M. Ellissen was President, a visit was paid to London, "where the English engineers received us with refined courtesy, and took us through their enormous works, and showed us their colossal gasholders."

The Exhibition of 1889 gave M. Cornuault, that year's President, the opportunity of showing how effective gas could be in comparison with electricity, by the gas lighting of the Trocadéro, the Eiffel Tower, and the Gas Pavilion. The presentation of Government medals to gas workmen having thirty years of loyal service, dates from the year 1898, when M. Delahaye was President, as he was also the previous year, when he reviewed the various means of illumination. In 1899, M. Th. Vautier compared the photometrical standards of different countries, and, as is well remembered, presided in 1900 at the International Gas Congress. The following year the Société Technique met at Dieppe, and went over to Brighton and London.

In this way, but, of course, much more fully, M. Visinet passed in rapid review the doings of past years, and gave interesting and pointed extracts from sayings of Past-Presidents, all profiting by their experience, advice, knowledge, and labour. Of the Société Technique it might be said that nothing which concerns the gas industry is foreign to it. The thirty volumes of its proceedings are "a valuable mine of documents offering rich veins to be exploited by seekers." The President concluded a very interesting address in a choicely worded final paragraph in which he gave an expression of his own affection for, and devotion to, the Société Technique de l'Industrie du Gaz.

The address was received with the most cordial expressions of satisfaction.

Distribution of Awards.

The report on the prizes of 200 frs. (£8) awarded by the Society to foremen and workmen who had given the longest and best service in gas-works was read by M. Delahaye. It showed that there was 102 candidates; but that only 70 were really eligible. Out of these, the Committee selected 32, whose length of service ranged from 32 to 48 years. Four of the selected candidates are employed by the European Gas Company—at their Havre (two), Trouville, and Rouen stations. M. Delahaye also read the report on the awards of silver medals (commenced last year) to inspectors, clerks, and others, for general good conduct and long service. The Committee selected 18, who had been at least 24 years with the several gas companies recommending them. Three of these are in the Company's service at Havre, one at Caen, and another at Amiens. Many of the selected candidates were in attendance to receive the awards, which were in all cases accompanied by words of congratulation and encouragement from the President or the Mayor, and by the applause of the assembled members of the Society.

A Special Award to an Old Servant and a Cordial Welcome to the Society.

A very pleasing—not to say touching—incident followed, when M. Gaston Gautier, the genial Engineer of the European Gas Company's station at Havre, rose to express the great pleasure he felt in being the medium for recognizing the long and faithful services rendered by a servant whom the Company were proud to number among their employees. For the long period of 51 years, M. Guignery had discharged the duties of lamplighter with a devotion and an assiduity which recommended him in a very special manner for an exceptional award. In the name of the Company they both served, he was pleased to present to M. Guignery a silver medal accompanied by a gift of 200 frs.

Thereupon the Mayor rose and congratulated the Society on having selected Havre for their annual congress, and offered a cordial welcome to the members, who could not, he said, fail to be well received in the town in which Philippe Lebon carried out his first experiments in lighting by gas. He spoke in appreciative terms of the system adopted by the Society of rewarding the workers in its ranks and in the industry which it represented. "It is an excellent custom," said the Mayor, "and one which is followed in other industries; and it would be very desirable if it became general. It is comforting to see old servants receiving marks of consideration and esteem on the part of their employers." Passing to the larger question of the relations of a public company to the municipal authority, the Mayor said:

> There exist, gentlemen, between the various towns and the companies you represent, communities of interests. Here, in Havre, the relations between the municipal authority and the European Gas Company are most agreeable, thanks to the amiability of M. Gaston Gautier, to whom I am pleased to render homage. M. Gautier has just handed to M. Guignery, a lamplighter of Havre, a reward for his long services. When a lamplighter has discharged his duties for 51 years in the same town, we are justified in regarding him as a municipal servant. It is my pleasure, therefore, to hand to him, in the name of the town of Havre, a silver medal which has been struck expressly for his acceptance.

The object of these marks of appreciation was very cordially applauded as he passed up the hall to receive his rewards.

Awards for Papers, Etc.

The report on the best papers submitted at the meeting of the Society last year was then read by M. André Coze. It set forth that the Committee had selected four, to the authors of which they awarded 250 frs. each—viz., the paper on "The Condensation of Solid and Liquid Particles in Gas," by M. Philippart; the two photometric papers contributed by M. Payet, the Secretary; and the communication on "The Lighting of Public Lamps at a Distance," by M. Casaubon.

A short report was read on the "Quaker" coke-stove, the joint invention of Messrs. Price and Webber, which was submitted in competition for the Society's prize. The various features of the stove, which is made by the Richmond Gas Stove and Meter Company, Limited, and has been described and illustrated in the "Journal," were briefly indicated; and the Committee awarded the inventors a silver medal and a diploma. Six candidates presented themselves for the prize of 5000 frs. (wholly or in part) for improvements in appliances for the automatic lighting of gas-burners. They were Messrs. Bruce and Rosie, and MM. Giorgi, Homburgen, Forti, and Japy. The appliances of the first two candidates were based upon variations in pressure; those of the next three, on the employment of electricity; and the last, on clockwork. The Committee fully recognized the value of the attempts made by the candidates to solve the interesting problem presented; but they did not consider they were justified in awarding a prize for any one of the appliances submitted in competition. Six makers of apparatus for the production of poor gas by the aid of coke expressed in the course of the past year their intention of submitting their appliances in competition; but only three were able to do so. They were MM. J. & O. G. Pierson, the Société des Moteurs Letombe (through the Fives-Lille Company), and the Société des Gaz Industriels of St. Quentin, who had sent a Dellwik-Fleischer generator for the production of water gas. These appliances were very carefully examined, and the reports thereon have been deposited in the archives of the Society for the inspection of the members. The results of the trials showed that gas coke, when used in generators producing either poor gas for motive power or water gas for use in illumination, is a fuel possessing very remarkable properties, and that even breeze may be most advantageously employed. In view of the perseverance displayed by the makers in the production of their appliances, and of the complete success attending their efforts, the Committee awarded a silver medal to each. There were three candidates for the prize of 5000 frs. for artistic fittings suitable for use with incandescent gas lighting—viz., MM. Charles Blanc, Charles Boulanger, and Eugène Potron. The Committee considered that all the fittings submitted were worthy of substantial recognition, and awarded each of the designers named a silver medal.

Reading of Papers.

The technical portion of the business of the Congress was then proceeded with; the first paper taken being that of M. Naudé, a Sub-Engineer at the Havre Gas-Works, on the lighting of railway carriages by compressed coal gas, a full abstract of which will be found elsewhere. The only speaker on the paper was M. Lecomte, who recognized the value of the paper, and added that it was to M. Gautier that the gas industry was indebted for the introduction of coal gas in place of oil gas—the only illuminant formerly considered possible of application—for the lighting of railway carriages. He gave what was practically a short lecture, with the aid of the blackboard, on compressed gas lighting for this purpose; and furnished some particulars in regard to the management of the carriages and lamps made by M. Henri Luchaire, the well-known lighthouse constructor. M. Naudé followed with a second paper on the De Brouwer conveyor at the Havre works, also noticed in another part of the "Journal;" but it did not elicit any remarks. It was well to dispose of these two papers early, in view of the visit of the members to the works at the close of the sitting. There they had an opportunity of seeing the compressing plant and the conveyor. The other paper taken was by M. Lecomte, on the subject of the new inverted high-power lamp of the Société Française de Chaleur et Lumière. In the first part of his communication, the author reviewed the work of former investigators into the subject of intensive lighting, and then went on to show how M. Clamond, making a clean sweep of existing processes, endeavoured to effect the complete combustion of gas, with the highest possible temperature, in the interior of a thorium mantle, without any addition of air to the exterior of the refractory tissue. In order to obtain the most intense lighting, M. Clamond tried to effect combustion in an inverted mantle; and in this he succeeded—producing once more, with considerable improvement, a high-power light by the aid of an inverted mantle, of which he was the originator 25 years ago. The problem to be solved was to bring into the flame a mixture of air and gas as highly heated as possible; but the difficulty presented itself that the hot air could not be raised to a sufficiently high temperature in such a mixture without risk of premature lighting. The author claimed that in the lamp shown in his paper this difficulty had been overcome, by the preparation of the slightly oxygenated primary mixture (3·5 volumes of air to 1 volume of gas), cold; and this mixture is burnt in the presence of secondary air raised to the highest possible temperature. Having next described the

construction of the lamp and explained the difference in principle between it and other burners, the author gave some photometric results obtained with lamps of 300 and 600 litres (10·6 and 21·2 cubic feet). Summarized, they showed that the unit of light was given with a consumption of less than 7 litres (0·25 cubic foot), with the production of from 400 to 900 candles per mantle. The author claimed this as an absolutely new commercial result. For a long time the consumption of 10 litres (0·35 cubic foot) of gas per carcel-hour had been the maximum yield of incandescent burners. In the lamp under notice, there is an improvement to the extent of 30 per cent. in the yield by the application of a new principle.

With this paper the first day's proceedings closed.

A Carbonization Paper.

On the resumption of the business on Wednesday morning, the first paper taken was one on "The Distillation of Coal," the combined production of MM. Verdier and Teulon. A practically full translation of it will be found in another part of the "Journal." It gave rise to some interesting remarks by MM. Chevalet, Lamy, Parsy (the new Editor of "Le Gaz"), Mallet, Frère, Cornuault, and the President; and though the conclusions arrived at by the authors did not mark any noteworthy advance, it was acknowledged that there were points in the paper which might be made the basis of an interesting discussion. Further reference to this communication, which is one of the most important in the list for the present year, may be made in a subsequent issue.

Papers on Various Topics.

Another paper which elicited some little discussion was the next one taken—that by M. Parsy, on the new electric lamps, and the position of gas in regard thereto, in Paris. The author began by pointing out that as long as the price of electricity was high in comparison with gas, the greater or less consumption of electric lamps was a matter of little moment to gas men. The space separating economically the two systems of lighting appeared, in fact, to be rather difficult to be passed over. Taking Paris as an example, at present prices the electric light is about ten times more costly than gas. It is since the introduction of the Auer burner, and the adoption of the incandescent system, that gas has found itself in a favoured situation, which has imparted to the industry renewed vitality; and this has given a further impetus to its hitherto interrupted development. In order to keep up this advance, those who are connected with the gas industry must not allow themselves to slumber on the path of progress. The electricians, on their side, have not remained inactive; and the object of the author was to indicate to his colleagues the lines on which they have lately advanced. He therefore passed in review the electric lamps which have lately appeared upon the market, from the introduction of the Nernst lamp in 1900 down to the Cooper-Hewitt mercury-vapour lamp, which has been in operation in Paris only a few weeks. The lamps described by M. Parsy were the Nernst (two types), the metal filament lamp of Messrs. Siemens and Halske, the osmium and zirconium lamps, and the mercury-vapour lamp referred to. He pointed out, in his concluding remarks, that these lamps are not by any means perfect. As he had intimated, they have defects which cause people to hesitate before adopting them. But these might, he said, only be "children's ailments," which would disappear with age. He then proceeded to examine the respective situations of gas and electricity if the good results claimed for the lamps described should be verified in actual work, and concluded by saying he thought these results should be brought under the notice of his colleagues. The President, and MM. Coze, Delahaye, Cornuault, Godinet, and Laurent offered some remarks upon the advisability of having them included in the proceedings of the Society. However, the author was thanked for his contribution; and later in the day, when the members visited the extensive works of the Westinghouse Company, they had an opportunity of seeing a Cooper-Hewitt lamp in operation—not to the improvement of the appearance of their complexions.

A totally different subject next engaged attention—viz., the lighting of lamps at a distance, which was introduced in a short paper by M. Crozet; and M. Frère gave an abstract, by the aid of the blackboard, of his paper on the automatic regulation of pressure in the town mains. There was no discussion upon them. M. Besnard described an appliance for preventing frauds by consumers resulting from the tilting of their meters. It elicited a few observations from MM. Maldant, Chamon, and other speakers. The next paper was by M. Dupoy, on a somewhat similar subject—viz., the preservation of the constant water-level in meters; but no remarks were made upon it. Another meter paper read on Wednesday may be conveniently noticed here. This was one by M. Naudé, who dealt with the respective merits of wet and dry meters. Wet gas-meters are in general use on the Continent; but dry ones are gradually being introduced. As far as Havre is concerned—the town with which the author is officially connected—15 wet meters have been in operation for the past three or four years without the slightest hitch. The conclusion arrived at by him was that the more general use of the dry meter would lead meter makers to devote greater attention to the construction of these instruments, so as to make their operation as accurate as possible. M. Naudé concluded by expressing the opinion that dry meters should be admitted for stamping as well as wet ones. Though the decision to this effect by the Weights and Measures Department of France had not yet been sanctioned officially, he thought gas suppliers would be justified in putting in dry meters. In the course of the discussion, one speaker said he had many dry meters in use, and the consumers were pleased with them. The President also testified to the desire of the consumers to have dry meters, and said he thought an effort should be made to have them stamped. M. Delahaye gave some interesting figures as to the sums realized from the stamping of meters; and MM. Chamon and Bigeard added a few remarks.

Water Gas Statistics.

One of the papers taken on Wednesday morning was by M. Delahaye. It was a summary of the official statistics relative to the use of carburetted water gas in England and the United States, and necessarily contained a mass of figures. It was not a "readable" paper; and therefore the author called attention to some of its principal features. He pointed out that the introduction of carburetted water gas into coal gas had been objected to on hygienic grounds, but without any argument being brought forward in support of the objection than this—that the gas was more poisonous than coal gas owing to the greater quantity of carbon monoxide in it. The object of the paper was to bring together some definite particulars, based upon official statistics, and draw from them replies to the various objections, far too theoretical, which the official representatives of science and hygiene are so pleased to raise. In 1901, M. Vieille, the Vice-President of the Conseil d'Hygiène et de Salubrité de la Seine, called the attention of the President of the Committee of the Société Technique to the dangers of carbon monoxide, and to the accidents of various kinds which had resulted from it, and deduced therefrom the necessity for limiting the quantity of this impurity in gas used for lighting, heating, and motive power. "If," said M. Delahaye, "these apprehensions were well founded, it may well be believed that in six years an opportunity would have been found for ascertaining how the introduction of carburetted water gas into coal gas is prejudicial to the public health." The author's statistics—the compilation of which, from the Board of Trade Returns, the reports to the Massachusetts Board of Gas and Electric Light Commissioners, and other sources, must have entailed a vast amount of labour—led him to the conclusion that the mixture of carburetted water gas and coal gas, in the proportions generally adopted in Europe, does not expose consumers to greater danger than ordinary coal gas, so far as concerns serious cases of poisoning. M. Delahaye did not in the least desire to minimize the poisonous properties of carbon monoxide. His observations were only made to show the one-sidedness and exaggeration of the accusations formulated on all occasions against gas by hygienists who are more prompt in condemning an accused than in seeking the real offender. The paper was received with considerable applause, and a few remarks were made upon it by the President and MM. Mallet, Cornuault, Verdier, and Lecomte.

This was the whole of the business at Wednesday's sitting.

A Pleasant Interlude.

On Thursday, at the invitation of the European Gas Company, the members, accompanied by ladies, had a delightful excursion by steamboat to Tancarville, an account of which is given in the notices of the visits.

The Closing Proceedings.

There was an early, though not a very full, gathering of the members on Friday morning, in order to dispose of the papers still remaining on the *agenda*. Before opening the business, the President expressed his thanks to his colleagues for the interest they had shown in the technical portion of the proceedings by their attendance at the reading of the papers, as it bore evidence that they had not been attracted to the Congress merely by the hospitality which had been extended to them.

The first paper taken was a short one by M. Chevalet, on the analysis of green sulphate of ammonia, a translation of which will be found elsewhere. He was followed by M. Casaubon, who gave the substance of an interesting paper on sulphocyanides, to which we hope to direct attention in an early issue. No remarks were made upon either paper.

At this point the business was suspended owing to the entrance of the Sub-Prefect, who had brought the medals and diplomas awarded by the Government to meritorious workmen engaged in the gas industry, which by inadvertence had not arrived in time for presentation at the sitting on Tuesday afternoon. They were five in number, and four of them were for men employed by the European Gas Company at Havre.

On resuming, M. Hovine brought before the members the results of a trial of the Hovine-Breuillé generator for the production of engine gas from coke and breeze, on which some observations were made by M. Lhomme, of Nanterre. The author then picked out certain portions of his paper for special notice, and summarized them. This paper, with one by M. Thelliez, on the application of the Morgan generator to the production of illuminating gas, which was not read, owing to the author's absence, M. Maggioni followed with the paper prepared by himself in collaboration with M. Bigeard on the systems of automatically lighting and extinguishing gas-burners; but, beyond a few observations by the President, no remarks were made upon it. The Secretary (M. Payet) then gave the substance of a paper by M. André Coze, on poor gas produced by the Letombe generator. The next paper

was one of an entirely different character. It was by Mr. Henry Laming, of Moscow, and dealt with new methods of remunerating workmen on the premium system. It was criticized by M. Gautier, who pointed out that the author said nothing about the quality of the coal and the quantity of gas made before and after the adoption of the system. Mr. Laming did not reply to the former point, but in regard to the latter said the quantity of gas produced per setting was about the same. M. Gautier remarked that since he had been at Havre he had been able to raise the charge of coal put into the retort from 140 kilos. to 175 kilos. without the introduction of any such method of remuneration as that outlined in the paper. Some additional remarks were then made by members on the paper by M. Naudé read on Wednesday, bearing mainly up on the question of stamping meters. M. Rieder followed with a note on his inverted burner. The technical business was brought to a close by M. Lecomte, who described the Luchaire-Lecomte light-standard, and also the method of making calorimetric tests of gas; the standard referred to and a calorimeter being on the platform for the purpose of demonstration. M. Verdier put some questions on the action of the latter apparatus, and they were answered by M. Lecomte, who then explained the method of employing oxygen for the prevention of asphyxiation by coal gas which was to have been dealt with in a short paper by M. Hedde. A paper by M. Eliot, describing a meter-tap which could not be tampered with, and another by M. Parsy, on pyrometers, were not taken, owing to the absence of the authors. M. Lecomte's communications are given elsewhere; and further notice of the more important of the rest will be taken in subsequent issues.

The President, announcing the close of the Congress, thanked the members for remaining till the end, as well as for re-electing him President. He also expressed his appreciation, on behalf of the Society, of the kindness shown to them by the town authorities, and especially by the Mayor. His remarks were cordially received by the members, and the business terminated.

VISITS, ENTERTAINMENTS, EXCURSION, "REMERCIEMENTS," "REFLECTIONS."

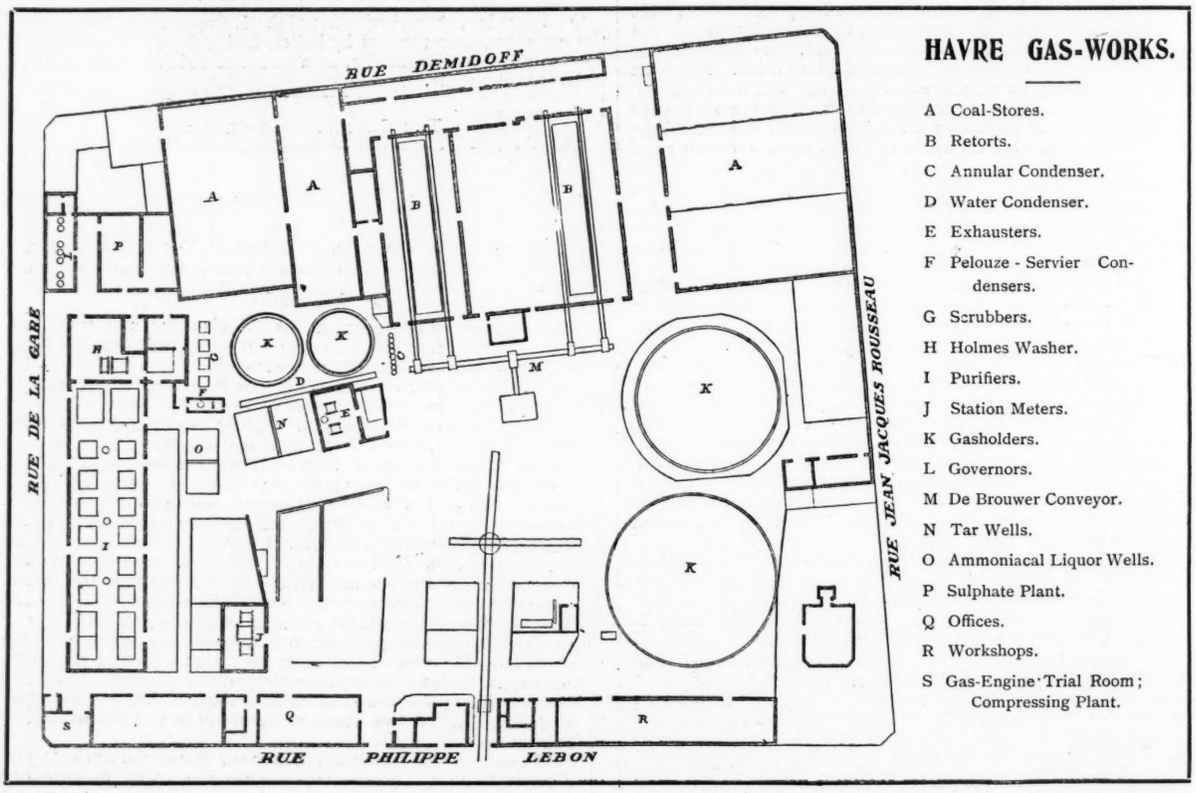
Havre is a town well known to English travellers, who spend a day or two there when passing to and fro on their journeyings to the quaint and historical towns of picturesque Normandy, in which all Englishmen are so interested. They know that it is the seaport of Paris; and with its 130,000 inhabitants, it ranks as second only to the port of Marseilles. They also probably know that it is a place of comparatively modern origin, having been founded by François I. early in the sixteenth century. They do certainly know of its fine situation at the mouth of the Seine, of its interesting docks, of its clean streets, of its spacious gardens, of its handsome buildings—such as the Hôtel-de-Ville, Bourse, and Palais de Justice—and of its attractive surroundings. No wonder, then, that the members of the Société Technique and their wives came in such large and almost unprecedented numbers to the Congress at Havre. But their primary duty is to gas; and therefore their first visit, on Tuesday afternoon at five o'clock, was to the works belonging to the European Gas Company. Electric trams—the excellent service of which is another notable feature of Havre—were generously provided, and conveyed the members from the Town Hall to the works.

The Gas-Works.

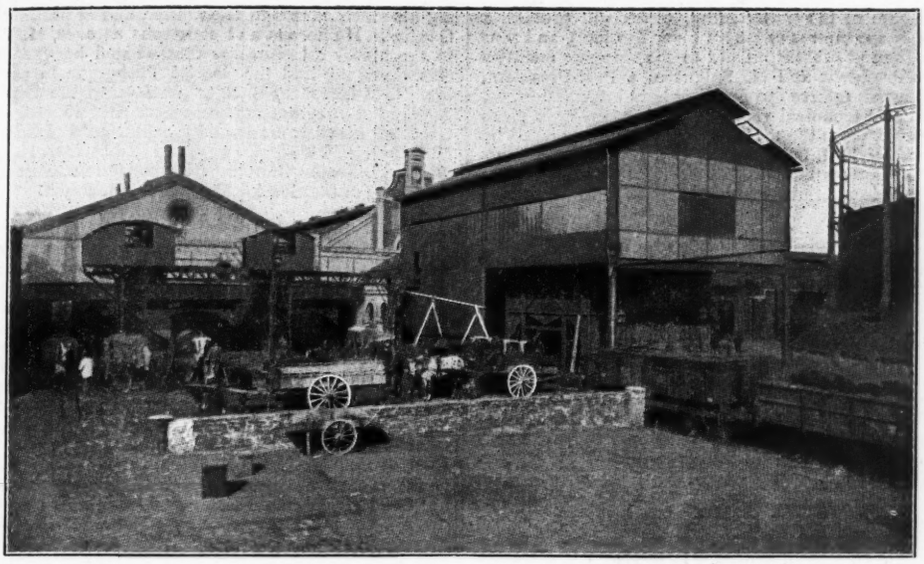
There is no need here to give any detailed history or account of these works; but it may just be mentioned that in earlier days there were two Companies lighting Havre, one French and one English. The former, whose works were near the centre of the town, were absorbed by the latter; their old works now being used merely as a gasholder station. The Havre works are the largest in the European Gas Company; those at Nantes being next in importance. Other towns lighted by the same Company are at Rouen, Amiens, Boulogne, Caen, and Bolbec. The greatest daily make of gas at Havre is about 60,000 cubic metres (nearly 2,200,000 cubic feet); while the annual amount of coal used is something approaching 50,000 tons, which is carted into the works from the boat, there being two sets of stores, of a total capacity of about 14,000 tons.

There are also two retort-houses, each having two benches, each of which has seven through arches having beds of seven ended retorts. At the time of the visit eleven of these through arches in one house were at work. The furnaces are ordinary direct-fired ones; and the charging and drawing are done by hand. The coke falls into a covered-in De Brouwer conveyor on each side of the bench. It is then raised by the incline of the conveyor, deposited overhead on to a cross conveyor, which feeds a primary screen, bye-pass shoot, and breaker, whence a bucket elevator lifts it to a fixed jigging and sorting screen over the storage hoppers for the different sizes of coke. There are at present no means of loading railway trucks direct from the hoppers. Local custom demands the sale of coke by measure in hectolitres, even when it is delivered in railway waggons. Two "National" gas-engines, each of 30-horse power, do the driving. This plant has previously been described in the "JOURNAL," and M. Naudé contributed to this year's meeting a paper relating to the subject, as given in another column.

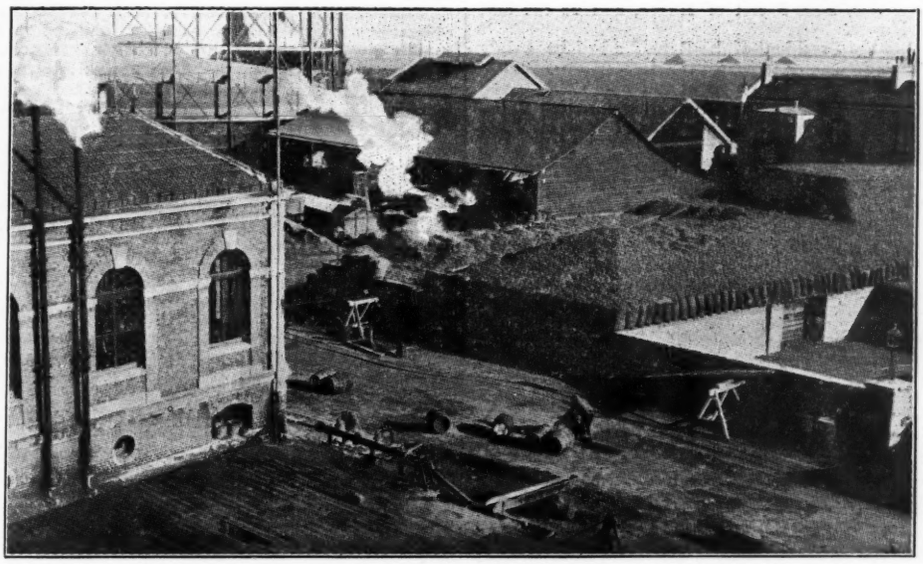
One item of interest in the retort-house was the system adopted of scurfing the retorts by compressed air; and one retort was being so treated when the party were there. A small annexe contains a 5-horse gas-engine driving a Farcot ventilator, giving a pressure of about 200 mm., or 8 inches. A 6-inch pipe leads the air from this to four mains running along the façades of the benches; a take-off T-piece being placed over the centre of each arch. To this T-piece suitable connections are joined for whatever retort is required to be cleaned; and when not at work the pipe is simply closed tight by a plug. The air discharges into a covered trough placed in the retort, which by this method is thoroughly scurfed in less than two hours, a considerable economy



GROUND PLAN OF THE HAVRE GAS-WORKS.



The De Brouwer Coke-Conveying Plant at the Havre Gas-Works.



General View of the Havre Gas-Works from the Top of the Scrubbers.

in time thus being effected, as compared with the former ordinary system in use.

The arrangement of the other apparatus at the works hardly calls for particular notice, and will be gathered from the preceding plan, which, with other information of a useful character, was given to the members in the form of a little booklet. It may be added, however, that there is a Holmes washer-scrubber employed for extracting cyanogen and ammonia from 72,000 cubic metres (2,500,000 cubic feet) per 24 hours. There are two preliminary purifiers, 6 metres by 8 metres (19·68 feet by 26·25 feet), 12 boxes, 4 metres by 4 metres (13·12 feet square), and four catch-boxes, 6 metres by 4 metres. The total gasholder capacity is 28,000 cubic metres (nearly 1,000,000 cubic feet); the largest of the four holders containing 12,500 cubic metres, or 441,500 cubic feet, of gas. The works presented a very clean and orderly appearance, and gave every evidence of competent management, which was only to be expected when it is remembered that they are under the supervision of so capable a Manager—one of so many years' experience—as M. Gaston Gautier, assisted also as he is by young engineers with credentials from the best engineering schools of France.

The visit, although offering no very noteworthy points of technical interest, proved highly gratifying to the many engineers and managers who were privileged to take part in it. At its conclusion, an adjournment was made to the Manager's garden, where Mr. R. Hesketh Jones, as Chairman of the European Gas Company, in a few well-chosen words, gave a warm welcome to the visitors, the popular Manager, M. Gaston Gautier, acting as interpreter. The toast to the Société Technique having been given, and suitably replied to by the President, M. Visinet, a photograph of the party was taken, after which a return was made to town.

Other Visits.

For the following afternoon, Wednesday, the 21st inst., two visits were arranged. The first was to the works of the Westinghouse Company, which are very similar to those of the British Company at Manchester, and, being well known to our readers, do not call for any particular observations. The Société Westinghouse was formed in 1901, and has two works in France—one being at Havre and the other at Freinville, close to Paris. On entering the works, one of the first things to attract attention was a three-cylinder Westinghouse gas-engine of 135-horse power, driving a dynamo of 6000 volts, which was having a trial run. Dynamos, motors, alternators, transformers, coils, and various accessories for electrical equipment were to be seen in all stages of construction, from the foundry to shipment or truck. A staff of engineers conducted small groups of visitors round the works, and were indefatigable in giving all the information that was asked for. Thanks are particularly due to M. Neher, the Manager of the Company, and to M. Buss, the Engineer and Manager of the works, for the courtesy of their reception. Among the many marvellous tools in the works, which proved of great interest, it was pleasing to see that at least some tools of English manufacture were in active operation, alongside others of American and French make.

The second visit of the day was to the site of the works in progress at the Port of Havre, where, after nine years, the formation of a new harbour is rapidly approaching completion. On arriving

at the end of the long Western arm, MM. Laroche and Balling explained the nature of the undertaking, which will provide a shelter for boats of 200 metres in length (over 650 feet), and thus tend, even more than at present, to add to the shipping facilities of Havre. The President and M. Salanson, a Past-President, thanked the Engineers referred to for their kind information.

The third and last technical visit of the Congress took place on Friday afternoon, when the members were again conveyed by tram to the works of MM. Schneider et Cie. (where the visitors met M. Canet, the famous inventor), a name known throughout the world for the manufacture of implements of war. But may peace prevail!

Soiree.

On the evening of the opening day of the Congress (that is on Tuesday), a musical *soirée* was offered to the Société Technique by the European Gas Company. It took place in the capacious rooms of the Hôtel Frascati, and the guests were received by Mr. R. Hesketh Jones, with whom was Madame Gaston Gautier, and also Mr. Henry E. Jones, as a Director of the Company. All the gas world of France—and his wife—were there; and it was indeed *une réunion charmante*. A refined and pleasing orchestra, the charm of Mlle. Lutzi (a laureate of the Conservatoire), the artistic *bizarrerie* of M. Galipaux, and other artists from Paris, all combined to give a delightful interpretation of M. Jelmo's well-arranged programme.

Annual Dinner.

The following evening members again assembled at the Hôtel Frascati for their own annual dinner. It is also a just tribute to the gracious hospitality of the European Gas Company, and Madame Gautier, to record that the latter presided, at the same time, at an adjoining dinner to some 35 ladies. At the more imposing (but less charming) function, on the right of M. Visinet sat M. Maurice Piette, Sous-Préfet of Havre, and on the left, M. Maillart, the Mayor.

After the toast of the President of the Republic had been duly honoured and the Marseillaise played, the esteemed President of the Société Technique made an excellent and humorous speech in eulogistic terms of all those guests individually invited to the banquet. He showed his inate courtesy and kind thoughtfulness by forgetting no one—always the true sign of a sympathetic spirit. He again thanked the Mayor for his interest in the gas industry, and for the special medal he had presented to the local lamplighter of half-a-century, M. Guignery. He paid a warm tribute to the qualities of M. Gaston Gautier, and to his interest in Art, for he was President of the very Society which was providing the excellent orchestral accompaniments to the dinner. M. Visinet named several engineers of Havre, and then mentioned Mr. J. W. Helps, who was present, and for whose kindness and cordiality at the Earl's Court Exhibition the French gas engineers visiting it were so much obliged. The President, after referring to the Chairman, Directors, and officers of the European Gas Company, called to mind a former meeting of the Société Technique at Rouen, the "sister city of Havre," and eulogized the well-kept gas-works. The Sous-Préfet, in a clever speech, described a friend's fears of gas explosions, but said that he had learnt the only explosions from gas were those of amiability and cordiality. The Mayor emphasized the friendliness of the relationship between the town of Havre and the English Company lighting it, adding significantly, "L'Entente Cordiale exists in 1905." Mr. R. Hesketh Jones then rose, and, speaking in French, reminded his hearers of his connection with them as a Director of the Union des Gaz, and also of the pleasure he had had in receiving them on the occasion of their visit to Brighton. The work of the Société Technique was very valuable to the cause of progress in the gas industry.

After "God Save the King" had been played and enthusiastically cheered, M. Cornuault spoke, first as the President of the Syndicat Professionel du Gaz—"a daughter of the Société Technique"—and again, as the eldest Past-President of the latter society, in reply to M. Coze. M. Brandt, as President of the Association des Gaziers Belges, responded to some further remarks by M. Visinet, who reminded members of the invitation to Liége on July 3, 4, and 5. Lastly, M. Gaston Gautier spoke, meeting with a very cordial reception. He thanked the Mayor for his appreciative remarks, and was entertainingly reminiscent of his former employment at Nantes before becoming the Manager of the Havre Works. M. Gautier characterized the treatment he had received at the hands of the European Gas Company as "large and generous," and thanked the administrators of the Company accordingly.

Excursion to Tancarville.

The hospitality offered to members of the Société Technique did not stop short with the *soirée*, but was extended to a delightful day's excursion on Thursday to, and *déjeuner champêtre* at, the little town of Tancarville, 18 miles from Havre, situated at the end of a canal joining the River Seine with the port. The return journey down the Seine proved most enjoyable, with bright sunshine and freshening breeze, pleasing music, and attractive views of Honfleur, Trouville, and Deauville. Mr. R. Hesketh Jones was, of course, the presiding host; and in the course of his after-lunch speech paid (in French) a much-appreciated compliment to members and their wives, mentioning also M. Malandain, the Deputy-Mayor, and M. Visinet. The former, for the Municipality of Havre, expressed his thanks for the "*belle réunion*," mentioning his indebtedness to M. Gautier, and in particular to Madame Gautier. Humorous and courteous as ever, M. Visinet referred to the kindly relationships that existed between the European Gas Company and the Société Technique in past times, when Mr. H. M'Lauchlan Backler presided at the Boulogne meeting. Applauded compliments were also paid to Mr. and Mrs. R. S. Gardiner for their many and gracious acts of hospitality. After M. Lecomte, in his fluent way, had thanked Mr. Hesketh Jones and others, M. Gaston Gautier performed the same service for the able Secretary of the Société Technique, M. Payet.

"Remerciements."

This brings us to our last word, which can only be, "Thanks, and again thanks." Where there has been so much generous hospitality, and such kind thoughtfulness, where the designers at the head of the organization have been so gracious, and the executive officers have been so willing, it becomes exceedingly difficult to give suitable expression to one's gratitude and appreciation. In this instance, it is rendered doubly so, for we feel that we must speak, not only for ourselves, but in some degree for more than one English visitor, and record our thanks at one and the same time, both to the European Gas Company, their Chairman, Directors, and staff, and also to the President, Council, members, and officers of the Société Technique du Gaz. Besides those whose names have already been mentioned, thanks are due to the General Manager of the European Gas Company, Mr. W. Williams, and to his Assistant, Mr. W. B. Brady, both also members of the Société Technique, to whose indefatigable and well-directed labours must be largely attributed the great success and thorough enjoyment of the Havre Congress. Obviously, upon the local Manager, M. Gaston Gautier, must have fallen a big proportion of the heavy work of organization, and to him thanks are in a very especial degree due. Also to his able Assistant-Engineers at Havre, MM. Naudé and Defoy, our obligations should be expressed for information and help most readily given. There are undoubtedly others on the staff of the European Gas Company—whose names are unknown to us—to whom we are also indebted, which indebtedness we here gladly acknowledge. Of the President of the Société Technique—M. Visinet—we can only say how appreciatingly we join in the general chorus of praise to his urbanity, unaffectedness, wit, and cordiality. M. Payet—engineer, secretary, writer, and linguist alike—maintained his high reputation for amiability and hard work; and so to him and others, we sincerely subscribe ourselves his and their debtors for the enjoyable Congress at Havre.

"Reflections."

A few reflections upon the meeting just closed may not be out of place here. If one were asked to describe in a single word its salient features, he would be confronted with a difficult task. Its success was due to a combination of two qualities characteristic of the nations on either side of the "strip of silver sea" which separates them; and therefore we must have recourse to the language of each to adequately describe it. It was the outcome of hospitality and *bonhomie*—using this word in its best sense of good-fellowship. Who could watch the genial countenance of the President without being conscious of his possession of a kindly nature? Who could receive his *poignée de main* without feeling sure that his friendship, once bestowed, would be sincere? The esteem in which he is deservedly held by his colleagues on the Committee of the Society was manifested by their re-election of him as President. Next to M. Visinet came M. Gaston Gautier—the personification of good-fellowship. One cannot imagine a man of his jovial disposition—the President of a local Musical Society—being a hard taskmaster. Who could be otherwise than touched at his remarks with reference to the lamplighter who had given 51 years of long and loyal service to the Company—a man whom they were proud and happy to number among their *personnel*, and whose devotion and assiduity they considered worthy of an exceptional reward? The visits to works, were further proofs of the heartiness of the welcome accorded to the Society. Of course, the members could count upon being (as they were) well received at the gas-works; and they might possibly have reckoned upon being shown over those connected with the harbour. But it was assuredly good-fellowship on the part of the Westinghouse Company not only to allow the members to inspect their vast shops, but to provide refreshment for them afterwards. It was courtesy also that enabled them to witness the inner workings of the extensive establishment of MM. Schneider et Cie. To a similar feeling was due the assistance rendered by the Tramways Company in conveying the members to the works named, and the granting by the municipal authorities of the use of the fine Chamber in the Town Hall for the meetings, and a room in the building for carrying on the secretarial work of the Congress. Finally, the weather was all that could possibly be desired. Members who arrived in Havre about five o'clock on Monday afternoon did so in a perfect deluge. However, the Clerk of the Weather—an official to be reckoned with on such occasions—was propitiated (doubtless by the affability of M. Gautier), and almost continuous sunshine during the day, succeeded by grand sunsets in the evening, was the result. The thirty-second Congress of the Society closed, and the members returned to their respective homes, with unclouded skies, and with the pleasantest recollections of a gathering which was generally acknowledged to have been one of the best in the annals of the association.

NOTES ON DE BROUWER COKE-CONVEYORS.

THE only paper read at last week's meeting of the Société Technique du Gaz dealing with constructional plant in gas-works was one by M. Naudé (of Havre), who gave some notes on the De Brouwer conveyor. These were largely the result of local experience with the conveyor, a drawing of the arrangement of which was given in the "JOURNAL" for Sept. 3, 1901.

The author prefaces his remarks by commenting on the great step taken of late years in the direction of applying mechanical methods to retort-house working; and he records the backwardness of France in this respect, until wakened up by the De Brouwer charging apparatus, which was seen at the Toulon Congress two years ago. In England, on the other hand, mechanical appliances were adopted at an early date, and the West and Arrol-Foulis machines are named; being described, however, as "very ingenious, but cumbersome and complicated."

The author disclaims the intention of trying to establish the superiority of the De Brouwer conveyor over others, but seeks rather to examine the principles which ought to be followed in installing such plant. "One most important point," he says, "in studying the adoption of a conveyor is that of its arrangements, so as to arrive at the minimum of cost for maintenance in regular working"—a somewhat nebulous statement, it may be remarked, of a sufficiently obvious truth. A certain amount for wear and tear is bound to be allowed for. But the author says that there is no need to exaggerate it, in view of the services rendered by conveyors. An essential condition is that all the parts of a plant should be of powerful output; for lack of efficiency in any one part prolongs the length of time the whole has to work during the operation of discharging. The more these periods of working can be reduced the better, and the less the wear and tear. The various drives ought to be easily accessible for examination and repair, and therefore placed at or above the ground level. Electricity offers great advantages for driving purposes; and with the switch-board in the retort-house, the starting and stopping of the plant can be controlled exactly to the requirements of the draw. The length of conveyors should not be great; it is much better to subdivide them. Thus in a works having two retort-houses, divided into four benches, it would be better to have a conveyor for each bench, all feeding on to a middle cross-conveyor. The advantages of this are: (1) Reduction in the length of chain, and therefore less expansion from the hot coke; and (2) reduction in wear and tear as a consequence of only having the conveyor in use which serves the bench that is actually at work at the time.

The choice and arrangement of the materials used in the De Brouwer conveyor have a great effect on its good working. Originally, wrought-iron plates and angles were used for the trough; but now, many seem to prefer cast iron. At Havre, the top overhanging guard angles of the trough were at once done away with, and soon afterwards, the wrought-iron bottom plates were changed to cast-iron ones about 1·200 m. (47¼ inches) long. The former plates buckled up and wore out very quickly. The latter plates, where butt-jointed, cause the bottom of the trough to lift, on account of the force of the water and small pieces of coke. Where they are bevel-jointed, they foul with the chain, and little by little get heaped up at the end of the trough. The author states that at the Crystal Palace Gas-Works, which he visited in December last, the wrought-iron trough has also been replaced by one in cast iron. "We are thus," he says, "very far from the original trough."

Similarly history repeats itself as regards the chain. Originally, male and female links were joined together by small pins in soft steel; then these links were strengthened and had heels or sliding blocks added, which, in spite of their being reversible, wore themselves out before the other parts. A detachable sliding link was tried; but M. Naudé thinks "there is yet better to be done in this respect," and he refers to a different type of chain shown by Messrs. Jenkins and Co., Limited, at the Earl's Court Exhibition. After contrasting chains made up of small parts, with those composed of large links, and remarking on the flapping on the sprocket wheels due to variations in the speed of the chain, the author touches on the question of the production of coke dust. At Havre, the quantity of coke dust has not been increased by the use of the De Brouwer conveyor. "In England, the country of coal, coke has not the same commercial value as in France, and no care is exercised in its manipulation." The author has been apparently struck with amazement at the fact that at the East Greenwich Gas-Works, the coke was seen to fall from the retorts some long distance into a subway. "These same principles show themselves fatally, in England, in the design and erection of mechanical appliances." What have our English manufacturers to say to this?

M. Naudé concludes by saying that the De Brouwer conveyor is an excellent apparatus, and works very satisfactorily under the following restrictions: (1) Convenient sub-dividing of the conveyors so as to avoid too great length of chain; (2) powerful output of the different parts, so as to reduce the periods of working; (3) ample capacity of the bunkers, so as to allow of storing different classes of coke during Sundays and holidays.

Thus concludes this Laodicean tribute to the De Brouwer coke conveyor.

NOTES ON THE CARBONIZATION OF COAL.

By MM. J. VERDIER AND P. TEULON.

[A Paper read before the Société Technique du Gaz.]

We have combined in these notes some results of investigations which we have made for several years past at the Marseilles Gas-Works, and which bring out the influence of certain factors on the products of the carbonization of coal.

PART I.—TESTS ON THE INFLUENCE OF WEIGHT OF CHARGES AND SECTION OF RETORTS ON CARBONIZATION.

The arches in use at the Marseilles works are beds of horizontal retorts, 3 m. (10 feet) long, and Ω in section. The first retort-house, with regenerative beds of nines, has retorts 600 mm. wide by 400 mm. high inside (23⅝ in. by 15¾ in.)—dimensions which slightly differ from those generally adopted, but which were originally chosen to suit American stoking machines, which have since been entirely done away with or transformed. A second retort-house has retorts with an inside section of 550 mm. by 350 mm. (21⅝ in. by 13¾ in.), 3 m. (10 feet) long, set back to back in beds of nines, which were heated by direct firing. They have just been altered to beds of elevens, with producers and regenerators, but retaining the same dimensions for the retorts. At the time of the commencement of these investigations, all the beds in this second house were direct-fired. It had always been noticed that the same coals behaved differently according as to which beds they were carbonized in. When, for a determined period of carbonization—140 to 160 kilos. (2·75 to 3·15 cwt.) in 4 hrs. 48 min.—the retorts in the first house gave rise to frequent stoppages in the ascension-pipes, and produced thick tar in the hydraulic mains and other condensing apparatus, the retorts in the second house, on the contrary, gave no indication of this, although it was easy to see that the charges were thoroughly carbonized. All the remedies that were tried in the first house—such as spraying the ascension-pipes—only proved insufficient palliations. It was impossible, owing to the arrangement of the pipes and apparatus, to separate the gas made in the two houses, and comparisons between their makes were impossible with any precision. It was, of course, said, but without any great conviction, that as the first beds had producers and were more heated than the others, there was nothing astonishing in the products obtained being different. This was an easy explanation and plausible *à priori*, but one which some pyrometrical tests quickly showed to be inadmissible; and so we were brought round to the decision that the form of the retorts was the cause of these differences.

Examination of the Tar.—The physical state of the tar being at that time our principal preoccupation (and not having a suitable plant for examining quantitative and qualitative results from the gas), our investigations referred exclusively to variations in the quality of the tar produced, according to the weight and duration of the charges. The very rudimentary arrangement adopted was as follows: A retort of the top horizontal tier was isolated from the general hydraulic main, and connected to a special one, from where, after passing the seal, the gas was sent back into the general main. We had not thus the whole of the tar produced, nor even the exact quantity of tar ordinarily deposited in the large hydraulic main; but our tests all being carried out under the same conditions, enabled us to compare the products of the different methods tried. Experience having shown that we could not carbonize in these beds more than 800 kilos. (nearly 16 cwt.) per day per retort, the tests had to be limited to examining the distribution of these 800 kilos. into four, five and six charges. The working in each of these three cases being maintained during several consecutive days, the tar deposited in the experimental hydraulic main was collected and examined in the following way: First of all, its density was ascertained, after getting rid of the water as far as possible; then the insoluble carbon contained in the tar, by draining off 100 grammes of it in a Payen apparatus, was dosed with benzol. All the liquid and soluble constituents were eliminated, and there remained in the phial of the apparatus a fine, powdery, dry dust, containing no volatile matter, composed of lampblack (resulting from the pyrogenous decomposition of the hydrocarbons) and of a little fine coal dust drawn in by the carbonization. At last 50 kilos. (1 cwt.) of the tar were distilled, and the products obtained fractionized roughly into light oils (up to 170° C.), heavy oils (170° to 300° C.), and pitch left as residue. The amounts of light oils, heavy oils, and pitch are calculated on a percentage of dry tar (deduction being made for the water collected at the distillation). The results obtained were the following:—

Charges of 800 Kilos. (16 Cwt.) of Coal per Day, Distributed into:

Tar from Hyd. Main.	Four Charges. 200 kilos. (4 cwt.) in 6 hours.	Five Charges. 160 kilos. (3·15 cwt.) in 4 hrs. 48 min.	Six Charges. 135 kilos. (2·66 cwt.) in 4 hours.
Density	1295	1321	1360
Light oils	1·25	1·07	0·80
Heavy oils	21·48	19·80	20·12
Pitch	75·50	77·70	78·24
Insoluble carbon	29·97	32·35	35·55

[Note, once for all, that these tests, and those which follow, were made with English coal, which is used exclusively at the Marseilles works.]

In the tar from the 4-hour charges, numerous soot balls, stuck together by greasy pitch, were noticed. They were less numerous in the tar from the 4 hrs. 48 min. charges, and hardly noticeable in that from the 200 kilos. in 6 hours. It was also remarked that during these tests the quantity and number of stoppages of the ascension-pipe decreased in a very marked degree from the first to the third test. These experiments, repeated several times, led us to adopt in this retort-house the distillation of 200 kilos. in 6 hours. This working, continued up to the present time, brought about a considerable alleviation in the work of the retort-house staff, especially as regards the hydraulic main, condensers, &c. The average tar produced by the works was improved, was more liquid, and no longer contained the soot balls which we had formerly noticed. Stoppages in the ascension-pipes, however, were not entirely overcome; and especially with certain qualities of coal, we still have, now and then, trouble in this respect. Further, there appears to be, in a general way, a slight diminution in the make; or, if wishing to increase the make, a corresponding reduction in the lighting power—that is to say, upon the whole, a slight reduction of the make in carcels per ton of coal carbonized, because the make in carcels per ton (see appendix) is the figure which allows of the best comparison between different coals, or between different distributing periods in the carbonization of the same coal. For these various reasons, it was decided to go on with the experiments in a more precise and complete way.

Experimental Works.—With this object, the Gas Company of Marseilles put at our disposal a perfectly fitted up experimental works, by which the most variable tests could be made with all the precision desirable. [The authors then proceed shortly to describe the works, which consisted of any retort whatever of one of the beds in fire, which could be isolated from the general hydraulic main, and connected up to a special small hydraulic main with a system of condensers, purifiers, meter, and holder.]

First Series of Tests. Influence of the Weight of the Charges.—Proceeding with the 800 kilos. per twenty-four hours as before, we completed our former tests by investigating the gas made (as regards yield and lighting power) in four, five, and six charges. The results were as follows:—

Charge of 800 Kilos. (nearly 16 Cwt.) of Coal per Day, Distributed into:

—	4 Charges 200 kilos. (4 cwt.) in 6 hours.	5 Charges 160 kilos. (3·15 cwt.) in 4 hrs. 48. min.	6 Charges 135 kilos. (2·66 cwt.) in 4 hours.
Yield in gas (cub. m. per 100 kilos.)	30·15	31·08	30·52
Standard (*Titre*) of Gas (Litres to the Carcel lamp)	114·63	110·54	106·27
Yield in carcels per ton of coal . .	2630	2810	2872

All these results are brought down by calculation to the temperature of 15° C. 760 mm. pressure, and saturated with water vapour at 15°.

These results were verified by many re-trials, with various coals; and the differences, more or less marked, remained always of the same character. This is, in our opinion, a very important point, to which, moreover, we shall have to refer again. An immediate conclusion to be drawn from these tests is that working in 6 hours stands out as slightly disadvantageous in comparison with the working in 4 hrs. 48 min. or in 4 hours, from the point of view of the gas results; but we could not think of taking on again in our retort-house the distribution of working previously done away with, as we knew too well the inconveniences of it.

Second Series of Tests. Influence of the Section of the Retorts.—It was therefore necessary to find out now a form of retort which would allow with our coals the working period of 4 hrs. 48 min. or of 4 hours. Daily experience showed us, as we said at the beginning, that the retorts in the second house (550 mm. by 350 mm.) permitted charges of 4 hrs. 48 min., and even in 4 hours, without causing the inconveniences from the tar noted in the first house. We thought then of comparing different types of retorts by means of our experimental works. For this purpose, we placed in the same arch of the first house, on the top horizontal tier, three retorts of different sections—one, the ordinary model of this house, 600 mm. by 400 mm. ($23\frac{5}{8}$ in. by $15\frac{3}{4}$ in.) of ⌂ shape; a second, something near the model of the second house 600 mm. by 350 mm. ($23\frac{5}{8}$ in. by $13\frac{3}{4}$ in.), also of ⌂ shape; and a third of almost rectangular section ⌂ 600 mm. by 350 mm. ($23\frac{5}{8}$ in. by $13\frac{3}{4}$ in.). This special form was tried in view of facilitating the working of the charging-machine actually in use. These three retorts were 3 m. (10 feet) long inside. The trials were carried out on two qualities of coal, with working periods of four, five, and six charges, for a daily output of 800 kilos. per retort. The results obtained are given in the table below.

These results show clearly:

1.—That, from the point of view of the quantity and of the quality of the gas, the three retorts tried give nearly identical results for the same working period.

2.—That the relative differences between the charges of 4 hours, 4 hrs. 48 min., and 6 hours, for the same total daily output, are maintained whatever be the model of retort.

The amount of insoluble carbon from the hydraulic main tar showed us, without need of more complete analyses, that the tar produced was of better quality with the second and third models than with the first, as was easy to be seen at the first glance; the stopping up of the ascension-pipes had been practically nothing with the second and third models, even when working 4 hours; while such stoppages were always evident in the first model when working 6 hours, were very troublesome with 4 hrs. 48 min. charges, and working became almost impossible with the 4 hour charges. Our belief was arrived at in relation to these three retorts; and in 1904 we proposed the adoption of the second model for four beds in the first house. These four beds brought in succession to five or six charges gave every satisfaction during last winter, and the transformation of the house will be almost completely finished in the course of the work of this year.

Conclusion.—We should not like anyone to deduce from the account of these trials, which were made to find out improvements in working compatible with the actual machines in our works, that it is indisputable and in principle advantageous for any works to have small models of retorts and to adopt 4-hour charges. Quite the contrary. And the arguments tending to lead to the adoption of heavy charges remain many and important. The advantages of drawing the charges in 4 hours, as far as concerns the yield in Carcels per ton of coal, are to be compared to the advantages of large charges of 6 or even 8 hours, from the point of view of the better quality of the bye-products, coke and tar, and especially—which is the most interesting and incontestable point to-day—from that of the relative importance of the labour. These different factors are essentially part of the local conditions relating to each works; the object of our paper is exclusively to give the elements of one of the factors of the problem. We may even add, by way of example, that, on the conclusion of our tests, it seemed to us, all being well considered, that the most favourable conditions for the Marseilles works were to be found united in the adoption, for the first house, of retorts of a section of 600 mm. by 350 mm. ($23\frac{5}{8}$ in. by $13\frac{3}{4}$ in.), and working charges of 160 kilos. (3·15 cwt.) in 4 hrs. 48 min.

Part II.—Various Tests and Theoretical Considerations.

It may be of interest to quote here the results of some different tests made in our experimental works. We wished to see what would happen if, leaving practical limits, we desired to divide the charges still more, and carbonize 800 kilos. per day in eight operations of 3 hours each. After the tests just given, we tried

—	Retort No. 1 (600 mm. by 400 mm.) ($23\frac{5}{8}$ in. by $15\frac{3}{4}$ in.)			Retort No. 2 (600 mm. by 350 mm.) ($23\frac{5}{8}$ in. by $13\frac{3}{4}$ in.)			Retort No. 3 (Rectangular). ($23\frac{5}{8}$ in. by $13\frac{3}{4}$ in.)		
	4 Charges 200 kg. in 6 hours.	5 Charges 160 kg. in 4 h. 48 m.	6 Charges 135 kg. in 4 hours.	4 Charges 200 kg. in 6 hours.	5 Charges 160 kg. in 4 h. 48 m.	6 Charges 135 kg. in 4 hours.	4 Charges 200 kg. in 6 hours.	5 Charges 160 kg. in 4 h. 48 m.	6 Charges 135 kg. in 4 hours.
COAL A. — 800 kg. per 24 hours.									
Yield in gas [cub. m. per 100 kg.] .	30·35	31·20	30·10	29·44	30·90	29·85	29·78	31·08	29·92
Standard (*Titre*) of gas . . . . [Litres to the Carcel lamp.]	115·43	111·15	103·25	110·55	109·02	101·74	112·82	111·34	102·18
Yield in Carcels per ton of coal . .	*2629*	*2807*	*2915*	*2662*	*2834*	*2934*	*2639*	*2799*	*2928*
Insoluble carbon (tar from hyd. main)	29·50	31·83	34·45	24·50	25·75	27·83	25·50	26·22	28·72
COAL B. — 800 kg. per 24 hours.									
Yield in gas [cub. m. per 100 kg.] .	32·02	31·95	31·54	31·07	31·78	31·05	31·48	32·10	31·33
Standard (*Titre*) of gas . . . . [Litres to the Carcel lamp.]	116·89	110·36	104·02	111·93	109·49	102·95	114·10	111·09	102·75
Yield in Carcels per ton of coal . .	*2739*	*2895*	*3032*	*2775*	*2902*	*3016*	*2750*	*2889*	*3049*
Insoluble carbon (tar from hyd. main)	30·50	33·05	35·72	23·25	26·50	29·48	24·33	28·50	29·41

the same coal in charges of 100 kilos. in 3 hours in retort No. 2. The results were:

COAL A.—800 KILOS IN TWENTY-FOUR HOURS.

Eight charges—100 kilos in 3 hours (Retort No. 2).

Yield in gas	31·86 c.m.
Standard (*Titre*) of gas	105·35 litres
Yield in Carcels per ton	3024
Insoluble carbon (hydraulic main tar)	32·55

As will be seen, the ascertained improvement in the yield of Carcels in passing from 6 hour to 4 hrs. 48 min. and 4 hour charges, continued for charges of 3 hours. We tried to pursue this series by having charges of 2½ hours, and even of 2 hours; but we were not able to work regularly under these conditions owing to continual stoppages in the ascension-pipe.

We also made, previous to this, some tests to ascertain the influence of variation in the output of the retort. With this object, we carbonized, in four charges of 6 hours, quantities of coal successively varying from 500 to 800 kilos. per day (9·84 to 15·75 cwt.). The temperature of the setting was regulated so that the carbonization might be completely effected without excess; the make remaining between 30 and 32 c.m. (10,764 and 11,482 cubic feet per ton). The following table gives the results:—

Six-Hour Charges—Retort No. 1.

—	500 Kilos. (9 84 cwt.) in 24 Hours.	600 Kilos. (11·81 cwt.) in 24 Hours.	700 Kilos. (13·78 cwt) in 24 Hours.	800 Kilos. (15·75 cwt.) in 24 Hours.
Yield in gas [c.m. per 100 kilos.]	32·3	31·7	31·1	30·7
Standard (*Titre*) of gas [Litres per Carcel]	110·5	109·5	109·9	110·0
Yield in Carcels per ton of coal	2940	2860	2820	2790

Thus the more one increases the quantity of coal carbonized in twenty-four hours, the less the yield in Carcels. In other words, there is an advantage in diminishing (remaining at least within the limits of our tests) the output of the beds from the point of view of the utilization of the raw material. These results are obviously only of interest from the strictly scientific point of view; the economical inconveniences of these units of working are too evident for them to be thought of for adoption. There is a correct medium, sanctioned by practice, from which one cannot deviate.

Theoretical Considerations.—We do not pretend to offer any complete theory of the whole of carbonization; but we think it right to set down some ideas on the question, hoping thus to provoke interesting and profitable exchanges of opinion. First of all, it is to be noticed that, in carbonization, as we work in practice, the most favourable conditions for good quality of tar are not the same as the most favourable conditions for the make of gas; they even seem to be in antagonism. It appears that the constituents of tar, oils of molecules more or less complex, are destroyed by a too prolonged stay in the free space of retorts under fire. This would explain that, in the same retort, the tar is more ruined with small charges than with heavy ones, and that, with the same charge, it is more ruined in a large retort than in a small one. On the contrary, we have just seen that the constituents of the gas, or those at least which give it its lighting power—the hydrocarbons, benzenes, &c.—with molecules comparatively simpler, are more affected by large charges than by small. Is it necessary to admit that these constituents of the gas are comparatively less sensible than the more complex components of the tar when in the free space of the retorts, and that they are, on the other hand, very rapidly decomposed by traversing a certain thickness of incandescent coke, as by surface action, so as to escape from the mass? One might thus explain that, in the case of carbonizing large charges, the gas produced at the centre, having to traverse a considerable thickness of coke all round, formed at the beginning of the carbonization, may—other conditions being equal—be of less good quality than when carbonizing small charges. It may also be admitted that the phenomena of carbonization have quite another aspect in the case of heavy charges than in the case of frequent light charges.

On the basis that the regular temperature of the bed remains practically the same to carbonize a given weight of coal in twenty-four hours, whether in four or in six charges, it may be conceived that, in the case of small charges, the coal being in lighter mass its temperature rises much more rapidly to attain the normal temperature of the retort than in the case of heavy charges. M. Euchène showed us, in his very instructive paper of 1900,* the rising curve of the temperature of a mass being carbonized in 4-hour charges. Direct pyrometrical experiments have given us analogous results; and we have been able to ascertain that, in the case of the heaviest charges, the rising of the temperature in the centre of the mass is clearly slower, which, moreover, is not surprising. It is to be supposed that the results obtained in these two cases are not identical, and that the splitting up of the volatile matters in the coal into different gaseous or condensable products becomes modified by these different working periods. Whether one or other of these explanations be adopted (and they both can be true, but we ourselves attach much importance to the latter), it is none the less true—it being an ascertained fact—that small charges run away from the heavy ones in the matter of yield in Carcels per ton of coal. If the improvements which it is possible to introduce in this direction, in the working of gas-works such as we know, are limited, as we have already said, by considerations of utilization of material and of labour, it may be asked if the direction hitherto followed by the gas industry is the only possible one, or if it could not openly be departed from. The realization of two extreme cases, at least in theory, can be conceived on lines such as these:

First Case: Carbonization of Large Tonnage during Twenty-four Hours.—This is, in fact, the plant of metallurgical coke-ovens adapted to the manufacture of illuminating gas. This solution, advocated especially in America, and recently at Munich, evidently offers *a priori* great advantages, from the point of view of the working costs per ton of coal, and of the superior quality of coke produced, &c. On the other hand, the very conditions of working coke-ovens appear counter to the conditions for good utilization of the raw material for the manufacture of gas.

Second Case: Accomplishing Carbonization in Small Lots and Applying the Principle of Continuity to the Manufacture of Gas.—This solution necessitates the creation of entirely novel plant; and trials in this direction are being made from different sides by means of vertical retorts with automatic charging and discharging. Vertical retorts were tried at the beginning of the gas industry; but it appears that it was desired to adhere to the principle of heavy charges, done at one time, and only to try to get from the verticality facilities of handling. These first attempts were abandoned. It seems that, with suitable modifications, vertical retorts could give a solution of the problem of carbonizing in small masses, by adding thereto the facilities of working inherent in the principle of verticality. It is to experience, and not only to reasoning, that we must look to show if one or the other of these solutions can permit us advantageously to transform our present method of working, and can help us to bear the burdens due to new demands of the workmen, the effects of which our industry feels so heavily.

APPENDIX.

We think it right to insist on the consideration of the yield in Carcels per ton. It is not enough, as is known (in order to compare results given by different coals, or with the same coal but with different periods of carbonization), to compare the yields in volume. It is necessary to take into account, at the same time, the lighting power of the gas made, and it is, after all, the relation of the yield in volume to the standard lighting power (*titre*) that gives the true value of a coal for use in the manufacture of gas—as long as the gas industry is tied to delivering a gas having a determined lighting power. This relation is the yield in Carcels (which the Germans call by a very expressive word the "Werthzahl"). Now this yield in Carcels is a constant for a given coal and an equally given period of carbonization. Even with considerable differences in the temperature of the bed, by reason of which the make of gas and the lighting power undergo great variations, the relation between the two remains all but without change. If it happens that the normal temperature of the beds is unduly departed from (for example, with the beds in our works, beyond the limits of 980° and 1080° C.), the yield in Carcels then varies slightly—decreasing for the too low temperatures, and increasing for the too high ones. This constancy of the yield in Carcels, observed also by other experimenters, greatly simplifies comparative investigations of the kind which we have just given. It is not obligatory to compare, as we have done, different periods of carbonization, or to regulate for each test, by repeated trials, the temperature of the bed so as to obtain equal makes of gas, and to ascertain the variations in the standard lighting power (*titre*) of the gas made. It is permissible, without any prejudice against the correctness of the conclusions, to take straight away, for the purpose of comparison, the yield in Carcels in any test made within suitable limits of temperature.

* See "JOURNAL," Vol. LXXVI., p. 1080.

RAILWAY CARRIAGE LIGHTING BY MEANS OF COMPRESSED GAS.

By M. NAUDÉ.

[Abstract of a Paper read before the Société Technique du Gaz.]

At the Congress of the Société Technique held at Nantes in 1881, M. Goelzer contributed a paper on the experiments which were then being made with the view of substituting compressed oil-gas lighting for the ordinary oil lighting then in use for railway carriages. Two years later, at the Marseilles congress, M. Cornuault described the new oil-gas works at the St. Charles station in that city, and threw out the suggestion that there was a new use for coal gas in this direction. The fact that many of the gentlemen attending the present congress were able to perform the journey to Havre in carriages lighted by gas compressed at the gas-works, is a proof of the practicability of the suggestion. The first attempts to light carriages by the incandescent system were made in 1897, but with only indifferent results. In 1901, the matter was taken up by the Eastern Railway Company of

France; but, as they employed oil gas in the ordinary service, they did not go on with the trials of coal gas, but adopted compressed oil gas. The results were, however, sufficiently conclusive to merit further consideration. The Eastern Company's trials had scarcely been completed when the Western Company began to experiment with incandescent lighting by compressed oil gas in the outskirts of Paris; and they attributed some of the good results obtained to the use of the Farkas inverted "Bébé" burner. Further trials showed its utility for the lighting of railway carriages.

In the course of the year 1903, the Western Company began to light their carriages with oil gas on the incandescent system. But towards the end of September, the principal Engineer of the technical service, M. Chapsal, instructed two of the Inspectors (MM. Bernier and Mondain) to put themselves in communication with M. Gaston Gautier, the Engineer of the European Gas Company at Havre, with the view of establishing a coal-gas compressing station there. It was arranged that the Gas Company should provide the station in order to allow the Railway Company to make their trials with the town gas on the ordinary working conditions of the Paris-Havre line. An important step was thus taken in favour of coal gas; but not before many objections had been overcome. As the time required for the equipment of the station by the Gas Company was rather long, the Railway Company themselves put up at the Havre Terminus an old vertical balance engine capable of compressing 350 cubic feet of gas per hour to about 17½ lbs.; and the first carriages lighted by it commenced running in May last year.

The Gas Company's installation was started in the following August, and it has worked satisfactorily up to the present time. The motive power is supplied by a 7-horse power gas-engine; and the compressing plant is of the type usually furnished by the house of Douane. It consists of two cylinders arranged in tandem—the larger one being 6¾ inches and the smaller one 2¾ inches in diameter—with 6-inch stroke. The force actually required to work it is 6-horse power; and the driving-shaft makes 200 revolutions per minute. The working capacity of the plant is 900 cubic feet of gas compressed to 50 lbs. per hour. The gas is sent into two storage waggons placed on a siding near the ordinary lines by means of iron pipes laid about 2 feet below the surface of the ground, and having a protecting covering of tarred wood. The total length is about 550 yards.

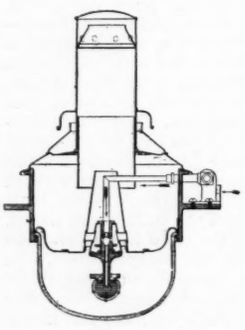


FIG. 1.

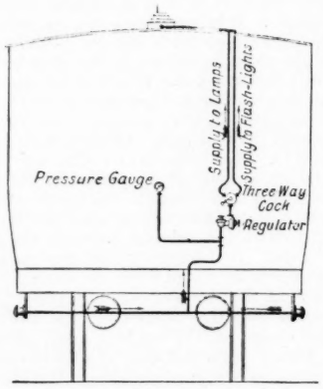


FIG. 2.

Each carriage is fitted with two cast-iron receivers running parallel with the framework. Their capacity varies from 7 to 25 cubic feet, according to the size of the carriage. Those which were formerly used for the compressed oil gas are only charged to 15 lbs. pressure; the new ones, however, were especially made to contain coal gas at 33 lbs. The lanterns in use are of two kinds —the "West" (fig. 1) and the Delamarre. It appears that the latter gives the best results. As a matter of fact, only two changes have been made in the oil-gas lanterns; but those to be constructed specially for incandescent lighting will differ materially from the others. For instance, they will be made so as to open from the inside, which will facilitate cleaning. Another improvement which is under trial is the provision of a flash-light, to be brought into use either by the Company's servants, by means of a three-way cock placed after the regulator, and allowing the gas to go into the supply-pipes to the burners and flashlight, to the latter only, or be shut off entirely; or to be operated from the interior of the compartment by the passenger, by means of a handle placed near the lantern, and enabling him to have the full light, to lower it, or to leave only the flash-light. This new arrangement (fig. 2) has been in use on a coach on the Paris-Havre line since early in May. The burners employed are, as already mentioned, the "Bébé;" and they give an excellently diffused light. Regulated for a consumption of 1·3 to 1·4 cubic feet of coal gas per hour at a pressure of 71-10ths, they produce a light of 32 candles; while with about 0·5 cubic foot of compressed oil gas, at about 48-10ths pressure, it was 30 candles. So that, about 2½ times as much coal gas as oil gas is needed to obtain the same illuminating power. The cost of compression may be reckoned at 7·5 c. to 8 c. per cubic metre (say, about 1s. 8d. per 1000 cubic feet), exclusive of the charges for redemption of capital spent on the station. The average life of the mantle is estimated by the Railway Company at 30 days; but this will be extended when the improved lanterns come into use.

The trials already made have given the Railway Company every satisfaction; and they are now carrying out, under the direction of M. Chapsal, a complete scheme of gas-compressing stations, comprising two in Paris (Clichy and Montmartre), and one each at Sotteville, Havre, Caen, Le Mans, and Rennes. The two Paris stations are actually ready for bringing into use. The Clichy station, which will serve the St. Lazare Terminus, will have two sets of plant, each consisting of three Douane compressors, similar in every respect to those at Havre, but enabling about 1800 cubic feet of gas to be compressed per hour. When the two Paris stations are in operation, the Railway Company will be able, with the one at Havre, to supply all the coaches running on the Paris suburban lines as well as a large number of those working on the Paris-Havre line.

The example set by the Western Railway Company has been followed by others. The Compagnie du Midi are about to put on trial 80 coaches supplied with compressed coal gas; and the Orleans Company intend making an experiment with coal gas, which will be supplied ready compressed by the Midi Company. The subject is under consideration by the Paris-Lyons-Mediterranean Company; but they possess installations of rich gas which they will probably utilize. In Italy, Sicily, Spain, and Austria, trials of compressed coal gas lighting are about to be made. In England they have already been commenced. Its successful employment for railway carriage lighting justifies the hope that it may in time replace oil gas in a number of its applications, such as for light-house illumination, buoys, and even for supplying the motive power on small steamboats.

It will be useful to give, in conclusion, some of the results of the Havre experiments in compressing coal gas. The operation gave rise to condensation of two liquids—water and benzol—which are separated in the vessel placed to receive them. At about 45 lbs. pressure, the proportion collected per 100 cubic metres (say 3500 cubic feet) of gas was 0·54 litre of water and 2·35 litres of benzol. Fractional distillation of the benzol gave on an average: From 50° to 80°, 4 per cent.; from 80° to 100°, 75 per cent.; and above this, 21 per cent.—that is to say, 75 per cent. of benzene and 21 per cent. of toluene. The effect of this condensation is a lowering of the illuminating and calorific power of the gas, and a diminution of its utilizable volume. Experiments undertaken with the view of determining the importance of these effects of compression were not sufficiently advanced to allow the author to give his colleagues any results. At the same time he stated that practice had shown that this reduction of lighting and heating power in the gas had little effect upon the luminosity of the mantle. As mentioned in his paper, the inverted burners used by the Western Railway Company give, at a pressure of 71-10ths the light of 1 carcel (9·6 candles) under excellent conditions of consumption.

THE CALORIMETRY OF GAS.

By M. A. LECOMTE.

[A Paper Read at the Meeting of the Societe Technique.]

One of the outcomes of the modern growth of the gas industry has been more precise and complete methods of analysis and measurement employed in the control of manufacture and of the quality of the products. In the early days of the industry, gas specifications simply stipulated for a supply of suitably purified gas delivered at a given pressure. Later on, large towns demanded, for burners used in public lighting, a certain consumption with a corresponding lighting power; and the most distinguished scientific men were called in for consultation on this question. Thus, in 1845, Arago, Fresnel, and Mary formed a Committee for the determination of the lighting power and of the consumption of the three types of butterfly burners adopted in the City of Paris. Afterwards, in 1862, the whole question was again taken up by Dumas and Regnault, inasmuch as it was then found that the burners specified for Paris in 1845 were not giving the proper lighting power. It cannot be supposed that the burners or the mode of manufacture of the gas had altered, and the fact, therefore, can only be explained by a difference in the coal distilled.

In 1845, the coal was that of Commentry—a supply which was exhausted by 1860. As we all know, the result of this inquiry by MM. Audouin and Berard was the adoption of a butterfly burner with a larger slit, giving with the gas, as then made, the necessary lighting power. Subsequently, Dumas and Regnault drew up their scheme of testing illuminating power and purification, with the object of insuring the continuance of the illumination specified at this period; and the text of their instructions is to be found in nearly all our modern treatises.

At the present day, we find ourselves in the same circumstances as those of 1860. The yield from gas coals now is far inferior to that from coals of fifty years ago; and the improvements in furnaces, and the almost universal adoption of extractors, while increasing the yield of gas from a given weight of coal, make it more and more difficult to obtain an illuminant up to the

standard 105. Further, the introduction, now almost general, of the incandescent system puts the lighting power of gas into the background; and, as M. Aguitton proposed in 1893, the heating power of gas may be taken as the criterion of its value.

Certain work of ours has led us to make a thorough examination of this question; and, although our personal view, already expressed to the Congress, is that the relation between the lighting and the heating power of coal gas is such that a measure of the former conveys the real value of the gas, we have nevertheless thought it worth while to study the calorimetry of gas at length. We therefore applied ourselves to the different calorimetric methods.

In any series of calorimetric tests the method must be to absorb the heat produced by a reaction or given off by a body; a measure of the quantity of heat produced and absorbed being obtained by observing the rise of temperature of a body of known specific heat. Among the different methods which can be employed for this purpose three only need be referred to in this connection:

(1.) Combustion of the gas at constant volume in a closed vessel contained in a vessel filled with water. This is the method known as the Berthelot bomb, the Mahler shell (or bomb), and the endiometric bomb of Witz.

(2.) Combustion of the gas at constant pressure in a receptacle at constant temperature. This is the process worked out by Dr. d'Arsonval, and includes a number of apparatus such as the calorimeters of d'Arsonval, of Mathias, of Hartley, and of Junkers, and, lastly, the instrument we describe fully, and with which our experiments have been made.

(3.) Combustion of gas at constant pressure in a burner of known dimensions below a vessel absorbing a known proportion of the heat produced.

The first method, at constant volume, is the only one considered exact by Berthelot in his treatise on "Chemical Calorimetry." Aguitton, in 1893, approved the Mahler bomb, which permits not only of measuring the calorific power of the gas, whether that be lighting gas or impoverished furnace gas, but also of making tests on coals and other combustibles. Aguitton criticizes the tests of Dr. Bueb made with a circulation calorimeter, in which it is difficult to obtain a current of water and gas properly regulated, and in which the liability to radiation is increased.

Professor A. Witz, before the Congrès de Mécanique in 1900, charged the burner calorimeters and those working at constant temperature with giving too low results in consequence of incomplete combustion; and he attributed to this fact the different results obtained by him on motors in which the yield of heat had been calculated from tests made in France with the endiometric bomb, while abroad the heat had been ascertained with the burner calorimeter. There is a good deal of truth in the criticisms which have been made on burner calorimeters; but we shall show that it is easy to remedy the defects complained of, and, on the other hand, that the calorimetric bombs have the defect of needing scientific supervision, requiring compressed oxygen, and absorbing a good deal of time for the tests. The degree of accuracy is certainly diminished by the difficulty of filling the bomb with the gas to be tested. To do this it is necessary to exhaust the bomb several times, to fill it with the combustible gas under small pressure, and to establish atmospheric pressure without admission of air into the bomb. These operations are not easy, and may give rise to errors amounting to $\frac{1}{1000}$ for a pressure greater or less than that of the atmosphere by 10 mm.

The third process is purely empirical, and does not claim accuracy, though it can be made of service and gives results in a short time. It consists in placing over a burner of a given type (the consumption of which can be carefully checked) a receiver full of water, for example, and in noting the increase of temperature for the combustion of a certain number of litres of the gas to be tested. Knowing the weight of liquid, the weight of the calorimeter, and the rise in temperature, we have data for calculation. It will afterwards be necessary to add the heat lost by cooling; and for this calculation we have given the elements in our study of heating by gas (Congress of 1902). Lastly, we must know the efficiency of the whole system—that is to say, the proportion of heat absorbed to that produced by the burner. This system is analogous to that of M. Giroud, brought before the Congress of 1903.

Passing, now, to the criticism of the burner calorimeters, M. Delahaye, replying to the second part of our paper on the use of the Junkers' calorimeter, cautioned us against the inaccuracy of calorimetric tests, and, in support of his contention, quoted the tests of M. Hendricson, in which this latter was found to be as great as 2 per cent. (working on the same gas), according to the ratio established between the consumption of water and that of gas. This observation has led us to undertake a series of tests on the measurement of the calorific power of gas, and we have set ourselves to work out a system as free as possible from the defects indicated by the authors we have quoted.

It was Dr. d'Arsonval who first suggested the calorimetric method at constant temperature, in which the calorimetric liquid circulates on the calorimeter so as to remove the heat as fast as the latter is produced; the temperature of the calorimetric vessel not varying during the course of the experiments.* The number of calories is calculated from the weight of the liquid, and the rise in temperature of the liquid. [This process has been worked since 1891 by M. Miculescu, for his calorimetric tests made to determine the mechanical equivalent of heat.] The inverse process has been applied by M. Mathias in his work on the heat and vaporization of liquified gases. In these experiments, the calorimetric liquid lost heat, and the heat absorbed by the vaporization was calculated from that given up by the liquid circulating in the casing of the calorimeter. The apparatus which we have used in our experiments is a closed calorimeter, devised according to Dr. d'Arsonval, in which we have introduced a certain number of special devices, with the object of minimizing the loss of heat, of regulating the current of water, and of absorbing the full total of heat produced by the reaction—that is to say, by the combustion of the gas in a suitable burner.

Burner calorimeters are actually water-heaters (geysers), in which the consumption of gas is sufficiently reduced so that the outer surfaces are protected against cooling, and so that the final efficiency of the apparatus should be as near as possible 100 per cent. We can get very close to this efficiency in the appliances referred to, but there is the inconvenience of the condensation of the products of combustion; and it is found in the course of a series of many observations that these condensed products rapidly oxidize the iron plates of the draw tubes. The only cause of inferior efficiency in a calorimeter—assuming the perfect combustion of the gas—is loss of heat, either by radiation or convection.

The loss by radiation is diminished by polishing the outer surface of the calorimeter, or, better, having it nickel-plated. The loss by convection is minimized by reducing as far as possible the loss by conduction. Wherefore we surround by a cushion of air the body, the cooling of which we wish to prevent. In spite of this, there is a good deal of conduction of heat; and it is the loss from this cause to which the differences found by M. Hendricson in his experiments are to be attributed. Now, the loss of heat by convection is proportional to the difference of temperature between the warm body and the air which surrounds it. The smaller this difference, the less the loss; and it is on this principle that we have devised our apparatus.

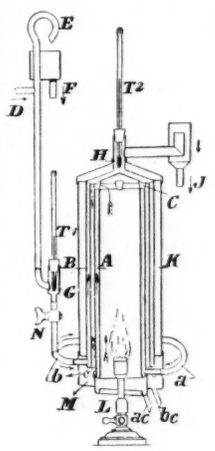


FIG. 1.

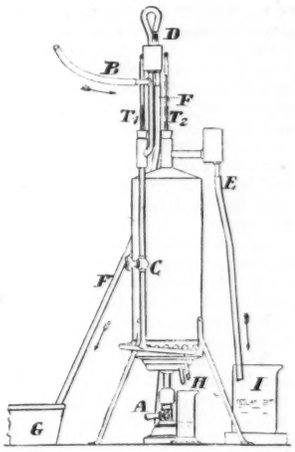


FIG. 2.

The Lecomte calorimeter differs from that of Dr. d'Arsonval in having—instead of one current of water and a single chamber traversed by the products of combustion—two cylindrical chambers. The result of this construction, as we shall see, is to diminish considerably the temperature of the outer chamber, and, consequently, to reduce the loss of heat by convection. Fig. 1 represents the apparatus. It consists of two concentric chambers A and B, for the circulation of water, connected by six tubes C, placed in the upper portion. These chambers are kept from cooling by a second receptacle K, which is nickel-plated and contains quiescent air. Water enters the apparatus by a tube D, surmounted by the curved tube E (discharging into a basin with overflow pipe F). A cylindrical chamber G, placed in the course of the water, receives the thermometer Y, indicating the temperature of the water at the inlet. Finally, two tubes *a* and *b* divide in a definite ratio the current of water between the two chambers A and B. The rising stream of water collects at the outlet of the two chambers in a small receptable H, which contains a thermometer T_2, indicating the rise of temperature due to the combustion of the gas. Lastly, the discharger I conducts the water into the basin, whence the tube J permits of its collection and weighing. The cock N serves to adjust the current of water to the volume of gas burnt, so as to alter to any required extent the rise of temperature of the thermometer T_2. The gaseous products of the combustion of the burner L rise to the inside of the first chamber A, descend between the two chambers A and B, and escape by the holes of the annular space M. The two small tubes *a c* and *b c* conduct the condensed water from the chambers A and B respectively.

* See "Ganot's Physics."

It will be seen at once from the figure that the quantity of water circulating in the chamber A is less important than in B; for the reason that it is here that the gas is warmest. The temperature of the water at the upper end of A will be greater than at the outlet of B. Chamber B, which completes the cooling of the gas, needs a larger quantity of water, as the equalization of temperature is less active owing to the small difference which there exists. In a test with our experimental apparatus to reduce the temperature at the outlet of A and B, we obtained the following results:—

Temperature at base of A and B, $T_1 = +\ 14{\cdot}8°$.
Temperature at top of A, $+\ 43{\cdot}1°$.
Temperature at top of B, $+\ 22{\cdot}5°$.
In the collector H, $T_2 + 31{\cdot}2°$;

Thus confirming the theory expressed above. The mean excess of temperature of the outer chamber B was as follows:—

$$\frac{22{\cdot}5 - 14{\cdot}8}{2} = +\ 3{\cdot}85°.$$

for a total difference of temperature of 7·7; the temperature of the surrounding air being equal to that of the water from a reservoir. If there had been but a single current of water, the mean excess of temperature would have been as follows:—

$$\frac{31{\cdot}2 - 14{\cdot}8}{2} = 8{\cdot}2°.$$

—say, a difference of temperature of more than double, and, consequently, a cause of loss of temperature likewise double. Thus the principle of the construction of the calorimeter with a double chamber carries out the requirements we have discussed above—of reducing to the minimum the difference between the calories produced and those observed.

In handling the calorimeter, it is placed on a board or on a small table at such a height that the thermometers are on a level with the eyes. Fig. 2 shows an installation consisting of an experimental meter for the gas, a balance with weights and tare for the vessel I, which can be either of glass or metal, and should contain from 3 to 4 litres of water. A vessel should be installed near to the calorimeter to receive the discharge water. The burner A is connected carefully to the meter with a piece of rubber tube, and on admitting gas from the meter (the cock of the burner A being closed), it should be seen that for a certain time the needle of the meter remains still—a proof that there is no leakage. The rubber tube B, conveying the water, is then fixed; and the tube F, which conducts the overflow into the discharge G, is likewise adjusted. The rubber tube E, which should be long enough to dip into the discharge G, is attached. It is put into the vessel I only during the period of an experiment. To make a test the inlet cock of the water supply on B is opened. Next the cock C is fully opened, and it is then made certain that the water is circulating properly. The burner is then lighted and adjusted to a consumption of between 100 and 150 litres, preferably 120 litres. The flame of the burner should include a green zone of from 8 mm. to 1 cm. high—that is to say, the bunsen should only take three or four volumes of air. The cock C is closed gradually so as to cause a difference of temperature of about 10° between the thermometers T and T_2. The calorimeter is then left to itself for a quarter-of-an-hour in order to be sure that all is right for making the test.

The test glass H, placed under the calorimeter, receives the condensed water arising from the combustion of the gas. At the moment of making the test, place the vessel on the balance, and balance it with the tare. Next mark on the paper the readings of the thermometers T_1 and T_2. As a rule, T_1 varies very little throughout a test. Next take the rubber E and quickly immerse it in the vessel. When the needle of the experimental meter reaches zero, place the vessel on the table. Note the reading of the thermometer T_2 as the needle passes 60, indicating 1 litre of gas consumed. Do the same at the divisions 120 and 180, afterwards taking the tube E in the hand, and at the exact moment when the finger reaches 240 withdrawing the rubber from the vessel and replacing it in the reservoir. If the test was done at 5 litres, the meter should be at division 300. In calculating the results, we can now take into account the various data that have been obtained:

T_1, temperature at inlet $+\ 16°$

T_2, temperature at outlet { 0° − 27·8 ; 60° − 27·6 ; 120° − 27·8 ; 180° − 27·8 ; 240° − 27·9 } Mean 27·8°

Temperature reached by water, $T_2 - T_1$, $= 27{\cdot}8 - 16 = 11{\cdot}8°$. Weight of water per 4 litres of gas, 1·705 kilos. Calories produced by combustion of 4 litres of gas, $1{\cdot}705 \times 11{\cdot}8 = 20{\cdot}119$. Calorific power of gas per cubic metre (water condensed to 16°), $\frac{20{\cdot}119 \times 1000}{4} = 5029$ calories. Afterwards, by calculation and by means of the usual tables, these results can be brought to atmospheric pressure of 760 mm., and to the temperature adopted. M. Berthelot, in mentioning his results, brings the figures to 0° and 760 mm. In the present instance, if the calorific power is taken at 0° the following result is obtained: $5029 \times 1 + \alpha t = 5029 \times 1{\cdot}058 = 5320$ calories. In interpreting the results of calorimetric tests, those obtained in the way we have just described include the heat of condensation of the water vapour; and it is logical that they should do so. Results in which the steam is left as uncondensed serve no practical purpose, for as a matter of fact in all the three ways in which gas can be employed—namely, for lighting, heating, and as a motive power—advantage is taken of the heat of condensed steam.

In lighting, it is not correct, of course, to speak of the calorific power of gas, but of the temperature of the flame. The warm gases leave the incandescent mantle at the temperature of the dissociation of water vapour. In heating (say) for culinary purposes the condensation of the water supplies an appreciable amount of heat. In warming rooms the water vapour loses its heat in the air of the apartment, and behaves as a gas of high specific heat, although it is not actually condensed. Lastly, in gas-engines, the water vapour plays an important part in the detent of the gases. Experiments on alcohol motors have already proved its usefulness in the products of combustion. The net result of the foregoing is that in all cases where heat is developed by the combustion of gas the water vapour is condensed and gives up its heat. Hence it seems logical to include it in the figures of the calorific power of gas. MM. Berthelot, Mahler, and Witz invariably adopt this course.

In regard to the figure which it seems most convenient to adopt as the calorific power of a given gas, we can quote the opinion of Professor Vivian B. Lewes, who, at the International Congress of 1903, stated that the idea of substituting the calorific test as a measure of lighting power did not satisfy him, seeing that his tests of gases of very different calorific power gave comparable illuminating powers. By the side of this opinion may be placed that of M. St.-Claire Deville, at the International Conference of Photometry, who, on the results of analyses of two very different coal gases—one of them being a poor gas of 4·475 calories per cubic metre at 10° and 760 mm., and the other a gas of 6·912 calories, under precisely the same conditions—found as the temperature of complete combustion for the first of the gases 1949°, and for the second 1950°.

It should not be forgotten that light by incandescence varies as the fifth power of the relative temperature, or as the fourth power of the absolute temperature (T+273). According to M. Guillaume, this rule would supply the explanation of the fact that coal gas in admixture with water gas gives photometric results with the incandescent mantle which are frequently greatly superior to coal gas employed alone. In regard to benzol, this, burnt in incandescent burners, gives for an equal consumption by weight a light superior to that produced by mineral oil; 1 gramme of benzol producing 10·5 calories, and 1 gramme of mineral oil 12 calories.

Calorific power is not the sole factor in incandescence. Dr. Bunte quotes the somewhat paradoxical case of coal gas containing 1·5 to 2 per cent. of carbon dioxide, which produced a light equal or superior to that of a gas free from carbon dioxide; and he explained this by the fact that the gas containing carbon dioxide was heavier, and drew in more air than did the pure gas. Coal gas in admixture with water gas is heavier than pure coal gas; and the effect is therefore much more marked than in the case of gas containing carbon dioxide. Water gas is not an inert compound, but gas producing a great deal of heat; and a dense gas will always obtain a better efficiency in a bunsen, and a more intimate and energetic mixture of air and gas. In the course of these tests, M. St.-Claire Deville concluded that the best gas for ordinary incandescent burners is lighting gas with a calorific power between 4800 and 4900 calories per cubic metre. In order to make the results comparable, it would be well to adopt the uniform rule of bringing calorific powers to volumes of gas measured at 0° and 760 mm.*

A word may now be said on the accuracy with which calorimetric measurements can be made. One must admit a considerable error in tests of this kind. These errors do not arise from the apparatus, for we can say that the accuracy of the instrument we have above described rivals that of an experimental meter. It is in reading the thermometers that the greatest accuracy is necessary, as an error of $\frac{1}{10}$th of a degree means $\frac{1}{100}$th on a difference of 10°.

Care should be taken to put the rubber in the test glass and draw it out when the finger arrives exactly at the point of the scale, as one division more or less amounts to $\frac{1}{2}$ per cent. of error. There is no advantage in burning more gas, as then the needle moves too quickly over the scale, and one has not sufficient time to place the rubber tube, which passes the warm water, into the vessel placed to receive it. If one has enough cold water at hand—say, at 10° or 12°—the difference in temperature can be increased to (say) 20°; and the errors of reading will then become less important. Under ordinary conditions, and by varying the consumption of water from 42 to 94 litres per hour, and the consumption of gas from 75 to 200 litres, we have not had 3 per cent. of difference between the highest and the lowest results. Working always in the same way, there should not be more than 1 per cent. of difference; and in making three tests with a quarter-of-an-hour between each and taking the mean, the results should be exact. We believe that our calorimeter is capable of being of direct service to all those who require to determine or examine the calorific properties of gas.

* For the past fifteen years in the gas-engine industry, sales and contracts, particularly those which are undertaken by corporations, state departments, arsenals, &c., demand that the volumes of gas should always be reduced to 0° and 760 mm.

A NEW PETROLEUM STANDARD OF LIGHT.

LECOMTE AND LUCHAIRE'S SYSTEM.

By M. A. Lecomte.

[A Paper presented at the Meeting of the Société Technique.]

In a memoir presented to the Congress of 1903, on "The Ratio of the French and German Photometric Standards," I expressed a wish that we should have "a secondary standard having a definite relation to that of Violle, capable of being prepared for work more rapidly than the Carcel, dispensing with weighing, and requiring simply the measurement of the height of the flame." It should, I contended, be "of greater intensity than the Hefner standard."

The International Commission on Photometry met at Zurich in June, 1903; and if it did not answer this question, it did at any rate decide that careful investigations should be undertaken on the relation between the Carcel and Hefner lamps, and between the Carcel and the 10-candle pentane standard of Mr. Vernon Harcourt—that is to say, a comparison between the Carcel standard, in which the lighting power is calculated from the consumption, and the two standards in which one need simply measure the height of the flame.

On the other hand, the first of these standards of which we have been able to decide the fixed character as a lighting standard, is of too feeble intensity (our experiments gave only 0·096 Carcel); and the second, which gives the Carcel with a flame sufficiently white and constant such as we have been able to verify in our experiments in England, has the disadvantages of requiring a liquid which is none too easily procurable, and of being adapted to our photometers with a certain degree of difficulty. The numerous photometric measurements we have made have led us to appreciate with special force the necessity of possessing a reliable standard having a definite relation to the Carcel; being rapidly made ready for use, and being free from appreciable variation during a fairly long series of measurements. Our experiments have been directed to the creation of a secondary standard, which is the subject of the present communication.

In our preliminary experiments on an ordinary petroleum burner, we had in mind the work of M. Monnier, who, more than twenty years ago, pointed out the advantages which it offers as a standard; and we have ourselves employed, since 1901, a similar petroleum standard worked out in conjunction with our colleague Desvisgne—at that time Chemist to the Société des Huiles Minérales de Colombes. The primitive apparatus which we employed consisted of a copper lamp, mounted on a grooved foot, with a Kosmos petroleum burner and a diaphragm cutting off the upper part of the flame. Simple though this lamp was, it gave us excellent results.

In the ordinary petroleum lamp, the wick does not invariably move straight upwards—a defect which prevents the upper extremity of the flame from being well defined; and, in proportion as the air is not properly distributed, there occurs a progressive overheating of the gallery and of the current of air which it directs on to the flame. It is necessary, therefore, to regulate the height of the flame several times with the wick pinion. We have directed our efforts to an instrument free from these defects, and have adopted the Luchaire 16-line burner, with a cylindrical wick, and with central and triple annular air draught. This burner is ready for action in two minutes, and does not afterwards vary appreciably for two hours; also its intensity is great—1·6 to 1·8 Carcel—and it is easy to cut down the height of the flame with a diaphragm so that the standard measures exactly one Carcel. M. Palaz, in his treatise on photometry, speaks highly of petroleum lamps as secondary standards in photometry.

Coming, now, to the Carcel as a secondary standard, one may almost say that, in view of the fact that the Violle standard is universally adopted, the Carcel is practically a secondary standard of light. Although the use of the Carcel as a standard has been codified by Dumas and Regnault, based on the work of Audouin and Bérard, it is because the Carcel was at that time the best lamp burning colza oil—a source of light which was almost exclusively employed before the introduction of petroleum. On the other hand, scientific men, such as Arago and Fresnel, have themselves used the Carcel for their photometrical work on the illumination of lighthouses.

It is curious to note, as proof that the Carcel standard has always been difficult to deal with, that Fresnel himself trimmed and kept in repair the lamps in his laboratory, in order to be sure of the constancy of their lighting. Notwithstanding its high price, the Carcel standard is of somewhat primitive construction—at any rate, in the burner portion. The burner itself is formed of two concentric cylinders of white sheet iron. The outside air supply of the flame is not controlled, and, consequently, through the gradual heating of the burner and of the supply of combustible fluid, the Carcel rises during the half-hour following its being lighted, and it remains constant only for about an hour before subsequently falling. It has been stated, in favour of the Carcel, that the use of purified colza oil is a guarantee of accuracy, inasmuch as colza seed being a fixed vegetable product, the oil is of constant composition, and should give the same light for the same consumption. This might have been true in the time of Arago and Fresnel, and even of Dumas and Regnault; but it is not so to-day.

As M. Suchetet notes in his report of Nov. 15, 1901, to the Chamber of Deputies, on vegetable oils, colza oil is adulterated by the addition to the colza seeds of other seeds, rape for example, and also by the addition to home grown colza of colza from the Indies, Cawnpore, and Férozepore. In 1901, by the kindness of M. Leprêtre, an oil refiner, of the Grand Montrouge, near Paris, we procured genuine samples obtained from home grown seed and from the Indies, and were able to make exact comparisons on the value of the Carcel obtained from lamps the burners in which were of the same size as in the Carcel burner. We found that the differences in lighting power were as much as 5 per cent., according to the oil employed. As a general rule, pure oil obtained from the French colza gives the greatest lighting power; but it is more and more difficult to procure such oil.

Turning, now, to the choice of petroleum, the composition of the latter is, we will admit, at least as variable as that of colza; and the variations in lighting power for a given weight can thus be considerable. However, it is not on the weight of liquid burnt per hour by which one works, but on the dimensions of a flame which is kept constant; and only a relatively small portion of this flame is utilized—thus further diminishing the causes of variation in intensity. Lastly, if a definite brand of petroleum is adhered to, there is a reasonable guarantee of constancy in the lighting power to a far greater extent than in the case of colza.

The best petroleums are distillation products collected at a given temperature and refined with great care. After having adopted a brand, one should stick to it. Referring to our communication of 1902, on the lighting constants of gas, it may be useful also to consult the work of M. Ringelmann on ordinary petroleum compared with "Stella" petroleum. It is this latter which we have used in our experiments.

Coming, now, to a description of the Lecomte and Luchaire standard—fig. 1—it is composed of a lamp A, having a slotted foot provided with a 16-line burner with central air draught on the Luchaire system. A box of blackened copper surrounds the flame, and has on the two sides two windows D, provided with blue glass E, and on the side facing the screen of the photometer, a window F with adjustable diaphragm G to cut off the upper part of the flame and reduce the intensity to one Carcel. On the glass H, at a height of 95 mm., a circle is marked, serving to regulate the height of the flame.

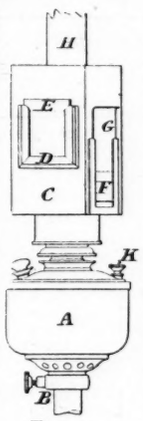


Fig. 1.

The foot of the lamp is made so that it can be used in place of the Carcel in the platform of the Deleuil balance, fig. 2. The weight of the lamp is calculated so that the balance does not strike the platform of the lamps resting below. To prepare the lamp, after having filled it with petroleum and cleaned it, the wick is lighted and immediately placed underneath the chimney—the latter previously well cleaned and polished. The wick is then raised by turning the adjusting pinion K until the top of the flame is about 1 c.m. below the mark engraved on the glass. At the end of two minutes, the flame will have reached the height of the mark, and will remain at this point for several hours.

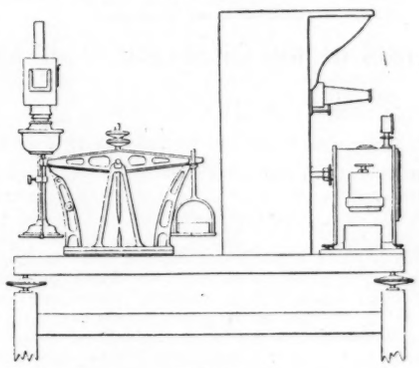


Fig. 2.

To extinguish the flame, it is only necessary to blow underneath the gallery of the burner. It is better to do this than to lower the wick, as it is then only necessary to light the lamp without making any adjustment the next time it is used. When the lamp is not in use, it is well to close the upper extremity of the chimney in order to exclude dirt and dust. A small wooden cover serves for this purpose.

In practical use, the new standard can be employed for the control of incandescent burners. But its value will be particularly appreciated in the actual manufacture of gas. The Giroud apparatus, which we have many times employed, and for which we have drawn up a table, is extremely useful; but the results obtainable with Dumas and Regnault would be much more valuable if so much time and care were not necessary in obtaining them. In a large works where the lighting power of the gas is properly controlled, it is one person's duty to make the necessary tests;

and these must therefore not be too elaborate. The Carcel must be got ready half-an-hour before it is wanted. Each test lasts about a quarter-of-an-hour; and one makes three, four, or more tests in an evening.

With the Lecomte and Luchaire standard, it is possible to make as many tests as one wants. Each will last for only a minute, as with the Giroud apparatus, or two minutes if the greatest accuracy is desired. We shall be ready for the first test at the expiration of ten minutes; for although the Lecomte and Luchaire standard is in working order at the end of the first two minutes, this is not the case with the Bengel burner, which requires about ten minutes in order to reach its maximum efficiency. The Lecomte and Luchaire standard is already employed in a certain number of gas-works, and has proved indispensable in those where carburetting by benzol is done. The following tables give the consumption per hour of the Bengel burner by observations extending over one and two minutes, and the consumption of the photometer meter, the dial of which was graduated in 25 litres.

TABLES GIVING THE VALUE OF THE GAS.

Period of Observation—One Minute.

Consumption for 1 Minute.	Hourly Consumption.	Consumption for 1 Minute.	Hourly Consumption.
1·40	84	1·90	114
1·45	87	1·95	117
1·50	90	2·00	120
1·55	93	2·05	123
1·60	96	2·10	126
1·65	99	2·15	129
1·70	102	2·20	132
1·75	105	2·25	135
1·80	108	2·30	138
1·85	111	2·35	141

Period of Observation—Two Minutes.

Consumption for 1 Minute.	Hourly Consumption.	Consumption for 1 Minute.	Hourly Consumption.
2·80	84·0	3·75	112·5
2·85	85·5	3·80	114·0
2·90	87·0	3·85	115·5
2·95	88·5	3·90	117·0
3·00	90·0	3·95	118·5
3·05	91·5	4·00	120·0
3·10	93·0	4·05	121·5
3·15	94·5	4·10	123·0
3·20	96·0	4·15	124·5
3·25	97·5	4·20	126·0
3·30	99·0	4·25	127·5
3·35	100·5	4·30	129·0
3·40	102·0	4·35	130·5
3·45	103·5	4·40	132·0
3·50	105·0	4·45	133·5
3·55	106·5	4·50	135·0
3·60	108·0	4·55	136·5
3·65	109·5	4·60	138·0
3·70	111·0	4·65	139·5
		4·70	141·0

ANALYSIS OF GREEN SULPHATE OF AMMONIA.

By M. CHEVALET.

[A Paper read before the Société Technique du Gaz.]

The trouble which makers of sulphate of ammonia experience in the sale of the green product is well known. In 1885, I presented a note on the subject to the Société, in which I attributed this colour solely to the presence of iron in the sulphuric acid. Being recently in communication on the subject with a maker of acid, the view was put forward that the green coloration of the saline product was due to the distilling apparatus; and I therefore made an analysis of the greenish salt, finding a percentage of matter insoluble in water, to the amount of 1·074. This insoluble matter consists of: Lead sulphide, 0·744 per cent.; arsenic sulphide, 0·330 per cent.

The greenish sulphate was fairly dry, and contained 20·6 per cent. of nitrogen; also a small quantity of sulphate of iron which came down as a yellow-red precipitate with the ammonia. It is singular that the greenish coloration should be due to a mixture of sulphide of lead, which is black, and sulphide of arsenic, which is yellow. Both the lead and the arsenic come from the sulphuric acid employed; and my conclusion therefore is that when this defect is noticed in the sulphate, tests should be made as to the supply of acid.

Apropos of the above note, it may be useful to recall the fact that in 1886 our colleague, M. Frère, ascribed the blue coloration of certain makes of sulphate to the attack of the iron tuyers by vapours of the ammonia evolved in the distilling plant, and containing the extremely volatile compound known as ammonium cyanhydrate.

From an article which I find in the Supplement to Wurtz's "Dictionnaire de Chimie," I see it is not ammonium cyanhydrate to which the attack of the iron is ascribed, but to ammonium sulphocyanide, which exists in the gas liquors in greater or less quantity according to the character of the coal which has been distilled in the retorts. The author of the articles explains the action as follows: "The ammonium sulphocyanide is in some small measure dissociated into ammonia and sulphocyanic acid, while the liquor loses by distillation the greater part of its ammonium sulphide. The sulphocyanic acid, on liberation, dissolves a corresponding proportion of iron-producing ferrous salt; the quantity of iron dissolved being just in inverse ratio to the speed of the evaporation."

I cannot say if this explanation is exact; but it seems to me that it is not, as one notices in the case of cast iron that no action takes place, and further that the sheet iron is attacked under many conditions, such as in the plates of meters, steam-boilers, &c., of the phenomena of which no satisfactory explanation has been given.

MANCHESTER AND DISTRICT JUNIOR GAS ASSOCIATION.

Visit to Littleborough.

The members of the above-named Association inspected last Saturday the works of the Littleborough Gas Company, through the kind invitation of the Directors, and were afterwards conveyed by waggonettes to the Lancashire and Yorkshire Hotel, Hollingworth Lake, where they were entertained to tea. The members assembled in the garden surrounding the gasholders, and one could not help noticing the healthy appearance of the trees. Here Mr. S. E. Halliwell, the Company's Manager and Secretary (a Past-President of the Association), introduced Mr. J. C. Hudson, a member of the Urban District Council, the Vice-Chairman of the Company, who, in the absence of the Chairman (Mr. A. Law, J.P.), welcomed the members, and expressed the hope that they might derive useful information from the inspection of the works. An account of these was furnished in a neat pamphlet, which was handed to each member.

The works, when the present reconstruction of the retort-bench is completed, will be capable of producing 500,000 cubic feet of gas per day. This can be increased to 600,000 cubic feet by extending the regenerative system in the present retort-house. The coal is carted from the sidings of the Lancashire and Yorkshire Railway Company at Littleborough—a distance of approximately a quarter-of-a-mile. The coal-stores are situated at each end of the retort-house, and have a capacity of about 800 tons, which provides for one month's maximum requirements. The retort-house, which was erected in 1865, is 60 feet long by 54 feet wide, and till recently contained six through arches, with twelve single settings of seven retorts each, 18½ in. by 14½ in. and 9 ft. 6 in. long, heated on the direct-fired principle. The bench is now undergoing reconstruction. Eight of the direct-fired beds have been pulled down; the remaining four being sufficient for the summer's demand. The new bench in the course of erection will be 33 ft. 9 in. long and 20 feet wide, containing three through arches, with six single settings of eight retorts each, 22 in. by 15 in. and 10 feet long. The new settings will be constructed on the deep regenerative principle, heated by Drake's tubular regenerative furnaces. Separate lengths of hydraulic main will be provided for each bed, with tar-main and flushing-out arrangement. The gas is conveyed by 10-inch and 12-inch foul mains, fixed on the inner walls of the retort-house and round three sides of the coal-stores, to the atmospheric condensers, which are of the annular type. This set of condensers was erected in 1887. There are two of Waller's rotary exhausters in use.

Gas was first supplied in Littleborough about 1843. Messrs. H. & L. Newall, who, at that time, occupied the Hare Hill Mills and Estate (which are opposite the present works), erected small works for their own requirements. Two local tradesmen undertook to lay a 2-inch main from the works to the village; and they supplied about a dozen consumers, at a charge of 7s. per 1000 cubic feet. The present Company was formed and the Act granted in 1865. They took over the Newall works, and increased the capacity of the plant in proportion to the requirements of the growing population of the village. The works were in charge of the late Mr. John Cockcroft from 1865 to 1901. The following figures will show the progress of the Company. In 1865 the annual make of gas was 5 millions; in 1875, 21 millions; in 1885, 38 millions; in 1895, 45 millions; and in 1905, 55 millions. The maximum day's supply is 380,000 cubic feet; the minimum, 60,000 cubic feet. The population of the district is 13,000; the number of ordinary consumers is 2800, and of prepayment consumers 250. There are 20 miles of mains.

In the absence of the President—Mr. H. Smith, of Bury—Mr. Hill (Stalybridge) voiced the hearty appreciation of the Association of the manner in which they had been entertained. Mr. Mottram (Ossett) proposed a vote of thanks to the Directors, and also to Mr. Halliwell and his assistants. Mr. Ginman (Tyldesley) seconded the proposition, which was cordially adopted. Mr. Hudson expressed the pleasure it had given the Directors to throw open the works to the Association, and said he was glad to notice the appreciation of the members. Mr. Halliwell responded on behalf of himself and his assistants.

THE PRESENT POSITION OF PHOTOMETRIC MEASUREMENTS.

By A. C. Jolley.

[A Paper prepared for the Optical Convention, 1905.]

Every branch of scientific inquiry is centred round some fundamental phenomenon, and usually develops along the following directions: (1) The investigation of methods of producing the phenomenon. (2) The measurement of quantities directly connected with it. (3) Its applications to the elucidation of scientific or industrial problems.

The fundamental phenomenon in optics is light; and although the science of optics has developed to great perfection along the last direction mentioned above, the first and second courses are by no means so perfectly developed, particularly by opticians in this country. This lack of attention to the production and measurement of light is probably due to the fact that the introduction of artificial illuminants is comparatively recent, and the early problems were almost entirely attacked by the aid of light from natural sources.

The production of light by artificial means opened up a new field of inquiry. It became necessary to know the cost of producing a given quantity of light; and therefore the subject of photometry has been subsequently largely developed by the gas and electrical engineer, while many important optical problems remain either untouched or imperfectly treated—due entirely to a want of specialized knowledge on the part of the optician in this particular direction.

This subject of photometry has, so to speak, been developed out of its own country of recent years, and bristles with problems which call for special optical treatment. Unlike most other scientific measurements, not only have we to deal with a physical quantity, but also a physiological phenomenon; and our ultimate measuring instrument must be the human eye. It is here that the optician, with his specialized knowledge of that organ and also of optical appliances, finds such important work awaiting investigation.

Although photometric measurements are comparatively simple, it is surprising how difficult it is to obtain accurate and consistent results. In fact, C. H. Sharp, in America, has put the limit of commercial accuracy at 2 per cent.—a figure that has been repeatedly confirmed by the author's own measurements, extending over a number of years. Higher accuracy can only be attained by taking extreme precautions. It will be seen that there must be considerable room for improvements in the photometric process; and I have therefore endeavoured to collect and bring before you the present aspects of the subject, in the hope that it may stimulate opticians to give their attention to the important optical problems which it contains.

There would seem to be two main causes for the unsatisfactory state of these measurements of luminosity: (1) The difficulty of standardizing and using the present working standards of light, which, in nearly every case, require laborious determinations of the condition of the atmosphere with respect to pressure, humidity, and impurity, or of delicate measurements of electrical pressure. (2) The fact that all our measurements must ultimately be referred to the eye as the standard piece of apparatus. Hence our measurements will depend upon a physiological sensation, which may, and does, vary with fatigue, alteration of wavelength, intensity, and pupillary opening.

The condition of health of the observer is also an important factor, and has great influence upon accuracy. A photometrical measurement is, therefore, not only the determination of an objective quantity, but is also subjective, since it must depend upon this physiological sensation.

Let us here examine the objects of photometric measurements: (1) We may wish to determine the intensity of a given source of light, expressing it either as the mean intensity given out in a horizontal direction or as the mean intensity falling on a spherical surface, having the source as its centre. (2) We may wish to determine the amount of light reflected, transmitted, or absorbed by a given substance or optical system. (3) We may wish to determine the illumination at a given place due to a distant source. (4) We may wish to examine the distribution of light from a given source.

Standards of Light.

It will be obvious that, before any of the above objects can be achieved, we must institute some unit, and create a standard representing that unit. Now it will at once be seen that since our measurements will depend, as mentioned above, upon a physiological sensation, we cannot have an absolute standard of light, and therefore our unit of light cannot be expressed in the "C.G.S." system.

In the early history of the subject, it was natural for investigators to turn to the most common source of artificial light for their unit; and hence arose the term "candle-power," and the endeavours to standardize candles to form a reproducible unit. In England, Germany, and France, standard candles have been produced, having specially-formed wicks, and designed to burn a definite weight of combustible per hour. But exhaustive researches have shown that these candles do not form suitable standards, since their light depends upon flame height, position of the wick in the flame, rate at which the combustible is consumed, and many other variables, which are, to a certain extent, beyond the control of the observer, and which lead to variations of considerable magnitude among the candles themselves.

However, in England the candle has been legalized by Act of Parliament; and although much abuse has been cast at the term "candle-power," it is, on the whole, a very suitable one. To the unscientific it conveys the idea of a suitable magnitude, which none of its proposed substitutes would do; while to the scientific observer the name is of little consequence, providing the quantity to which it is attached is capable of definite specification. The candle, therefore, remains as our unit; and we must seek some way of reproducing its light-equivalent by such means as will render it invariable under all conditions.

For this purpose there are two methods open to us—viz., we may raise a body to a definite degree of incandescence, and measure the luminous radiations from a given area of its surface; or we may burn some combustible in a burner of definite dimensions with a definite flame-height. Of these two methods, the first would at first sight appear to recommend itself on the score of definiteness, since we are only required to provide an area and a definite temperature. But we must first carefully inquire into the nature of the radiation given out by a body as its temperature is increased.

Some Old Radiation Standards.

In 1847, Draper announced that if any solid body had its temperature continuously increased, it would become visibly hot at a definite temperature, and that the spectrum of the light so produced was a continuous one. This temperature—at which a red glow was just visible—was given by Draper as 525° C. As the temperature was raised, shorter wave-lengths were added. Thus a body at 720° C. emits all wave-lengths between the A ($\gamma = 7604$) and C (6562) lines; at 780° C., it extends from A ($\gamma = 7604$) to G (4307); and at 1165° C., it includes all wave-lengths from A ($\gamma = 7604$) to H ($\gamma = 3967$). Above this temperature the ultra-violet radiations are added. In 1887, H. F. Weber discovered that the first visible radiation from the heated body was not the red glow observed by Draper, but was a kind of indefinable grey which made its appearance in the spectroscope in a region corresponding to the yellow or greenish-yellow; and that the temperature at which this glow was observed was not the same for all bodies,* but having passed this point the brightness of the body increases very rapidly with the temperature. It is due to the misunderstanding† of Kirchoff's law of 1858 that Draper's law was unopposed for so long. According to this fundamental law of Kirchoff, every body emits at any temperature wave-lengths which it itself absorbs at the same temperature. This law was generally understood to apply to gases instead of solids, and was usually treated from this point of view.

The Kirchoff Law.

R. von Helmholtz, in 1889, pointed out that one of the reasons why Kirchoff's law held for solid bodies only was that since the absorption was so great in a solid, practically no rays could pass up from the interior to the surface, and we could therefore speak of the emission per unit surface. But in the case of gases, not only have we the surface emission but also an interior emission which can be varied with the pressure. Hence Kirchoff's law may be expressed by saying that, for every wave-length, the ratio of the emitted energy to the absorbed energy is at a given temperature independent of the nature of the body when the light and heat emissions are due to heating, or to what R. von Helmholtz has called "regular" radiation.

It is understood from the above that the body absorbs all the energy which falls upon it, and does not transmit or reflect any. Such a body does not exist, but forms the ideal black body of Kirchoff; and its absorption co-efficient would be unity. In lamp-black and spongy platinum, and many other black bodies, we have very fair approximations to the ideal black body; but unfortunately they are nearly all destroyed at very high temperatures. We may, however, produce an absolutely black body by other means; for, according to Kirchoff's law, the constitution of the radiation pervading an enclosure with perfectly opaque walls at a definite temperature is a function of the temperature of those walls and of nothing else. Hence, if we imagine an enclosure—a hollow sphere, say—having a small aperture in it, and whose interior surface is coated with some black substance, if a ray enters obliquely at the aperture, it will be entirely absorbed in the interior, and we shall have realized our ideal black body. Any ray in the interior of this sphere will in quantity and intensity be equal to that coming from an absolutely black body at the same temperature. Some black bodies of this nature have been set up at the Reichsanstalt, consisting of carbon tubes heated to

* Sitzungber der Berliner Acad. (1887), p. 491.

† "Engineering," Vol. LXXVI. 1903.

incandescence by an electric current, and protected by external jackets of carbon and other materials; and with such black bodies, Lummer and Wein have shown that all bodies radiate in exactly the same way in the interior of a hollow space kept at a uniform temperature.

From the above we conclude, therefore, that since a black body will radiate as much energy as it absorbs when equilibrium of temperature is established, its radiant energy must be a maximum. The distribution of this energy in the spectrum of the black body, however, shows that most of the radiant energy is composed of wave-lengths too long to affect the eye; but there is a distinct shift towards the visible wave-lengths as the temperature is raised (see fig. 1). It is, therefore, obvious that, apart from experimental difficulties, the absolutely black body is not a good light radiator; and we must therefore seek a substance which will absorb and emit more luminous rays and transmit or reflect more heat-rays. Furthermore, this source of luminous radiation should be white, and must therefore include the whole of the visible spectrum. Therefore, from what has been said above, it must be capable of withstanding a temperature of not less than 1165° C.

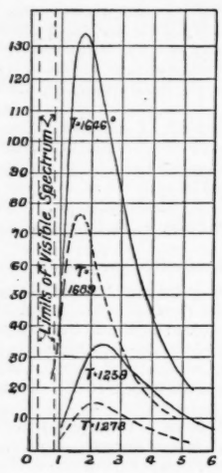


FIG. 1.—RADIATION CURVES FROM RESULTS OF LUMMER AND PRINGSHEIM.

Black Body—Full Lines.
Bright Platinum—Dotted Lines.

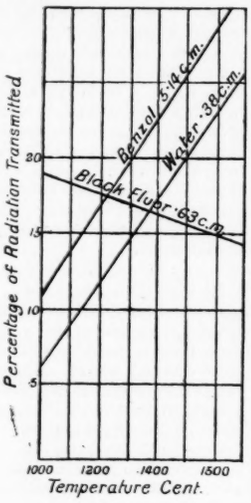


FIG. 4.—ABSORPTION CURVES (PETAVEL).

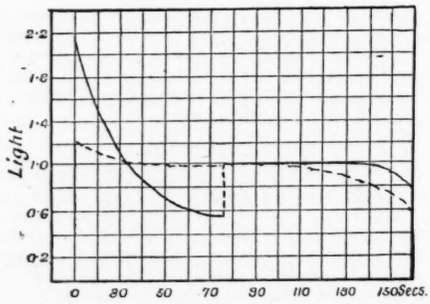


FIG. 2.—CURVES FOR MOLTEN PLATINUM (PETAVEL).

Since the body is to be a good reflector, we are limited practically to metallic substances; and of these only iron, nickel, gold, palladium, iridium, and platinum have melting-points high enough. Of these, gold is but little above 1165°; iron and nickel are not reliable at high temperatures; and iridium disintegrates. Platinum, on the other hand, seems pre-eminently suitable, since even in the liquid state it has a beautiful mirror-like surface. It is very unoxidizable, and can be procured in a high state of purity. Further, Lummer and Pringsheim have found that, at a red glow, it radiates less than one-tenth of the energy of an equivalent black body, and at the highest temperatures less than half (see fig. 1).

Violle's Definition of the Unit of Light.

M. Violle in 1881 first proposed to define the unit of light as the light emitted normally from 1 sq. cm. of molten platinum at its solidification temperature. He conducted researches with such a standard and demonstrated its superiority. In his researches* he used a large quantity of the metal (1 kg.). This was heated in a lime crucible by means of a blow-pipe burning oxygen and illuminating gas; and when the metal was melted, the rays from the surface were either directly received on the photometer screen, or reflected on it by means of a mirror. The temperature of solidification was indicated by the sudden increase of brightness (or flash) which always accompanies it, and which is easily appreciated on the photometer. The Congress of Electricians at Geneva at 1896 adopted, as the unit of luminous intensity, the candle—defining this to be represented by the bourgie-decimal of the previous Paris Congress of 1889, which defined the bourgie-decimal as $\frac{1}{20}$th of a Violle unit. But, from the very outset it was obvious that the platinum unit would not be commonly employed. In adopting this unit, therefore, the Conference cared more for the unification of photometric standards than for the creation of a light standard for photometric work.

Curiously enough, M. Violle in his researches makes no mention of any special difficulties in setting up his standard; and yet Lummer and Kurlbaum, at the Reichsanstalt, mention that it was tried and abandoned, owing to difficulties which arose from the impurity of metal and consequent change in surface; while Petavel in this country succeeded in reproducing it only by taking very special precautions.*

Petavel's Research Work.

From his researches Petavel drew the following conclusions: (1) The ingot of metal should not be less than 500 grammes. (2) The crucible should be of pure lime. (3) The metal should be chemically pure. (4) The hydrogen must contain no hydrocarbons. (5) The gases must be burnt in the proportion of 2 volumes of hydrogen to 3 volumes of oxygen. Illuminating gas was found to be unsuitable by condition 4.

If the above conditions are satisfied, it is probable that the variation of the light emitted is not greater than 1 per cent. It must not, however, be overlooked that the standard temperature is a transitory one; the period of constancy depending upon two things—viz., the weight of the ingot employed, and the initial temperature to which it is raised. Petavel has shown that unless a fair superheat be allowed, the curve does not suddenly rise to the constant temperature point, but gradually falls until it reaches it. The constant portion which then merely forms an inflection in the curve is somewhat difficult to determine (see fig. 2). The duration of this constant period is, under the best condition, some 50 seconds; and there is, therefore, some difficulty in making measurements "on the wing," as it were. Indeed, Petavel used a self-registering photometer-bench in his observations, in order that no time should be lost in observing and recording.

The employment of oxy-hydrogen fusion, with the necessarily elaborate apparatus connected with it, has rendered the use of the platinum standard difficult and troublesome, particularly since measurements must be made by a series of re-heatings, as it is not possible to keep up a steady supply of heat.

The employment of electric fusion, as a possible solution of this difficulty, has been investigated (but without much success) by Petavel. This lack of success is probably due to the fact that he endeavoured to regulate his heating by adjusting a current of some 2000 ampères on a mercury resistance. Now it is well known to electrical engineers that to control such a large current directly by a resistance is by no means easy; it being very difficult to hold it for any time to a steady value. Small changes in the current make relatively large changes in the heating. Petavel found that it was not possible to fuse bars of more than 70 sq. mm. section with 2000 ampères, and, further, that even then they deformed their supporting trough of lime, became irregular in cross-section, superheated locally, and finally ruptured the circuit.

He then tried, with considerably more success, fusion in a crucible of nickel constructed in such a fashion that it could be kept cool. Under these circumstances, the platinum was melted in a crust of solid metal; but the quantity of fused metal was insufficient for working purposes.

Petavel next suggested, but did not try, an alternate current transformer to supply his heating current; and the same solution independently occurred to Dr. Drysdale and the author before we were aware of the details of Petavel's work. Such a transformer has been designed; and we are hoping in the near future to construct it.

Proposed Electrically Heated Platinum Standard.

The following is a brief description of the instrument: The transformer is of the shell type, having a primary circuit designed to receive a supply at 100 volts 50 v. This is inserted in the groove of the channel section secondary, which consists of a single casing of copper. This disposal of the coils will, therefore, reduce magnetic leakage to a minimum. The platinum, which is to be raised to incandescence, will be cast between the horns of this secondary turn (which will be cooled by water supply), and will be contained in a crucible of pure lime, or a nickel crucible constructed on the plan devised by Petavel. The floor of the crucible will be so shaped that the heating will be localized to the central portions of the strip—in fact, we hope to form a little lake of molten metal surrounded by walls of the solid metal itself.

From the dimensions, I have calculated that about 140 grammes of platinum will be required. The capacity of the transformer will have to be about 6 kilowatts; and consequently the primary current, at 100 volts, will be 60 ampères—a current capable of easy and exact manipulation.

* "Lumière Électrique," Vol. XIV., p. 475.

* J. E Petavel, "Proceedings of the Royal Society," Vol. LXV., p. 649.

Fig. 3 is reproduced from the constructional drawings. It shows the apparatus to be compact and simple; and it should be possible to control the heating with a great degree of precision, and hence

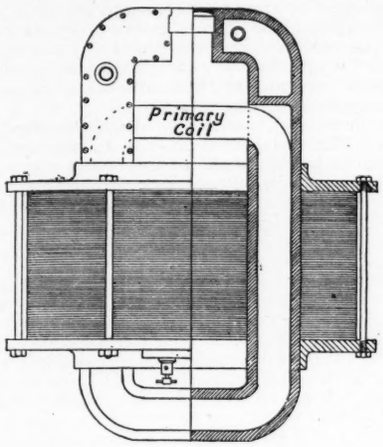


FIG. 3.—PROPOSED ELECTRICALLY-HEATED PLATINUM STANDARD.

prolong the period of solidification considerably, and at the same time use only about one-fourth the quantity of platinum specified as necessary by Petavel.

The Difficulties to be Overcome.

It will be gathered from the foregoing that the production of a standard of light by such simple means as raising a solid to a definite degree of incandescence, is beset with such difficulties as to render it impractical as a working standard, although both Siemens and Libenthal have endeavoured, by fusing a platinum ribbon with an electric current, to produce a secondary standard on this principle. It has been proposed independently by Mr. Swinburne,* Professor S. P. Thomson,† also by M. Blondel to use as the standard of light the radiation from one square millimetre of the crater of a direct-current silent arc between carbon electrodes. M. Blondel and M. Petavel have both conducted careful measurements of this quantity. The choice of such a unit is based upon the hypotheses that the crater of the arc is at a constant temperature—that of the volatilization of carbon—for it has been observed that the area of the crater increases in proportion to the current, and that the light increases in the same ratio as the area of the crater. Further, Sir W. Abney has shown that the light emitted from the crater has always the same spectral composition; and hence the temperature of this light-emitting surface must be constant. This, in fact, ought to be the case if the latent heat of vaporization of carbon is a positive quantity; for when this temperature is reached, and volatilization has commenced, the temperature cannot rise any further.

Blondel's Experiments and Conclusions.

M. Blondel's measurements‡ were conducted with a projector lamp—an image of the crater being formed by means of a pin-hole diaphragm placed close to the arc and kept cool by water circulation. An inverted image of the arc was thus formed upon a screen which contained an aperture of definite dimensions arranged to fall well within the luminous area, and the radiation from this aperture was then measured. The little hole in the cold diaphragm was liable to become blocked with carbon dust; and to obviate this difficulty, Blondel proposed to use a lens of known surface and co-efficient of absorption to form the image. By this means, the lens could be placed some distance from the arc, and the water cell omitted.

From his experiments Blondel drew the following conclusions: (1) The average brilliancy of the incandescent portions of the arc, taken as a whole, increases with the current, and also with the current-density, until the crater is saturated. (2) If the current is suddenly altered, the intensity drops until the crater adjusts itself to saturation. (3) The carbons must only contain small amounts of foreign substances. Most carbons were found to contain not more than 4 per cent. of impurity, 2 per cent. of which were mineral salts. The intrinsic brilliancy is given by Blondel as 160 bourgie-decimals per sq. mm.

Further Researches by Petavel.

The above researches were repeated by Petavel § in this country in a very thorough manner, using an arc with carbons at right angles as well as several other forms. The objects of his researches were as follows: (1) To determine the average brilliancy of a normal (silent) arc. (2) To determine, when conditions are carefully specified, if variations are still too great to allow the use of this source of light as a standard. (3) What effects are produced by the use of excessive currents and current densities, and by surrounding the arc by an enclosure maintained at a high temperature.

The results of these inquiries, he sums up as follows: (1) The intrinsic brilliancy of the crater of a silent arc is about 147-candle power per sq. mm. (2) Even under the most favourable conditions it is difficult to obtain consistent results; variations of 5 per cent. not being infrequent. (3) Variations in the size of carbons, in intensity and density of current, in length of arc, and in total power expended as long as the arc is silent, do not cause the intrinsic brilliancy to vary more than 10 per cent. on either side of the mean. (4) The enclosure of the arc in a chamber maintained at 900° C. does not cause any sensible variation in the intrinsic brilliancy.

From the above conclusions, it will be seen that, although experiments confirm the theory that the crater of a carbon arc is at the temperature of the volatilization of carbon, owing to the difficulty in obtaining consistent results, its employment as a standard is at present not advisable. I should, however, like to raise one point of criticism here. M. Blondel gives as the value of the intrinsic brilliancy of 1 sq. mm. of the arc crater—160 bourgie-decimal. Now a bourgie-decimal is one-twentieth of a Violle unit; and Violle gives the value of 18·5 English candles to the platinum unit. Hence, on this basis, M. Blondel's value for the arc in English candles is 148-candle power. Petavel has quoted 19-candle power for the platinum unit;* and even upon this basis M. Blondel's value is only 152-candle power. The highest value of the bourgie-decimal I can find recorded is 0·984 British candle (a none too reliable figure); and only by using this does M. Blondel's figure reach 157·4-candle power. The mean value of the bourgie-decimal from M. Violle's and M. Petavel's experiments (which are the only direct determinations) put M. Blondel's value for the arc at 150-candle power.

Now it will be found that M. Petavel has quoted M. Blondel's value as 158-candle power; and this has been several times copied by various writers on this subject without comment. It is interesting to note that M. Blondel quotes in his paper† the figure 158 bourgie-decimals as a value obtained by him; but in his final conclusions he prefers the higher figures, all of which are given in bourgie-decimals.

If the above reasoning is correct, then the only two direct determinations of the light emitted from the arc crater are in much closer agreement than is usually supposed, and the value of the light as a standard is considerably enhanced.

The Improvement of the Violle Standard.

In consequence of the difficulties experienced in obtaining consistent results with the Violle standard at the Reichsanstalt, Drs. Lummer and Kurlbaum were led to adopt another method of forming a light standard. In their arrangement a strip of platinum foil of standard dimensions was raised to incandescence by means of an electric current; and the temperature was adjusted until one-tenth of the total radiation was transmitted through a thickness of 2 cms. of water contained in a trough having quartz sides. This ratio of radiation was measured by means of a bolometer—an instrument consisting of a delicately constructed platinum grid. The radiation falling upon this grid alters its resistance; and if therefore it be included in one of the arms of a Whealstone bridge, there will be a disturbance of the bridge-balance, due to the changes in resistance, the amount of which will be proportional to the radiation falling on the bolometer.

Petavel, during his researches upon primary standards of light, investigated the possibilities of this standard, but did not come to very favourable conclusions. The electrical measurements required to be made with great precision, while the bolometer itself was difficult to adjust to constancy when measuring the ratio of the radiations by different methods. A change of bolometer made considerable alteration to the value of the standard; while the adjustment of the current (about 80 ampères) was, except under the most favourable conditions, tedious if not impossible. It is possible, however, that this adjustment might have been simplified considerably by the use of a transformer. Finally the light emitted was too red for general working, although this defect is not so important where (as in the Reichsanstalt) the standard is set up for standardizing Hefner lamps.

As an outcome of this unique and valuable work upon primary standards of light, M. Petavel‡ came to the conclusion that only three substances are available as radiators—viz. platinum, platinum-iridium (25 per cent. iridium), and iridium. He gives the intrinsic brilliancy in candle-power per sp. cm. as 19, 34, and 290 respectively. The intensity of the light emitted from iridium near its melting-point is remarkable—being some fifteen times that of platinum; but unfortunately the foil disintegrates at this high temperature if the heating is continuously maintained. The next important point is that of temperature regulation, and here he finds it best to determine the temperature of the radiator by means of the relative intensity of the radiation of two different wave-lengths.

For metallic radiators, as for a black body, the wave-length at which maximum radiation occurs is in inverse proportion to the absolute temperature. Two wave-lengths are therefore selected—one in the infra-red, and one in the visible spectrum. If we

* J. E. Petavel, "Proceedings of the Royal Society," Vol. LXV., p. 649.
† "Journal of the Institution of Electrical Engineers," Vol. XXI., 1892.
‡ A. Blondel, "Electrician," Vol. XXXII., p. 117. § "Proceedings of the Royal Society," Vol. LXV.

* "Electrician," Vol. L. † "Electrician," Vol. XXXII. ‡ "Electrician," Vol. L., p. 1012.

measure in each case the energy of radiation in percentage of the total, we shall find that, as the temperature increases, the former decreases and the latter increases, and at one temperature only will they be equal.

For purposes of analyzing the radiation, the difference in thermal absorption of various bodies was investigated. For most substances, it was found that the percentage of heat transmitted increased with the temperature of the radiator—with one exception, black fluorspar. Now since water and glass are practically opaque to radiations of greater wave-length than 3 μ, and black fluorspar is entirely opaque to the visible spectrum, these substances may be used for analyzing the radiations from the radiator. To secure accuracy, the rate of variation with temperature should be large, and water, benzol, and glass all fulfil this condition (fig. 3).

The standard (fig. 4) is obtained by dividing the light from the radiator into three beams. One, passing through a window of black fluorspar, falls upon the face of a thermopile. The second, passing through a window of water or benzol, falls upon a second thermopile. These two piles are connected in opposition through a sensitive galvanometer; and when this instrument reads zero, the temperature is right, and the central beam is then of the right intensity and can be used for photometric comparisons.

Although this method has some advantage over the Lummer-Kurlbaum standard from the simplicity of its electrical adjustments, the use of thermopiles and their attendant troubles is an objection, since they are very liable at times to give uncertain indications of small differences of temperature.

Schwendler has proposed to use a horseshoe-shaped platinum strip mounted in an exhausted bulb and raised to incandescence by an electric current; but the suggestion has never been largely adopted, owing to variations in the emissive power of the surface of the strip, alteration in cross section, and other troubles of a like nature.

Carbon Filament Standard Lamps.

Sir W. Preece and, later, Edison in America have proposed the use of carbon filament lamps; but the objections to this standard may be summed up as follows: The light-giving power of the filament varies from the following main causes: (1) Changes in resistance of the filament. (2) Changes in the surface of the filament. (3) Projection of carbon on to the interior of the containing bulb.

The convenience of a glow-lamp secondary standard cannot, however, be disputed, since it is independent of all external atmospheric changes (with perhaps the exception of temperature); and this has led Professor J. A. Fleming to devise his standard form of lamp. According to his experience, it is possible to bring a good carbon filament into a constant condition by running it for some fifty hours at slightly more than its rated voltage. The filament so aged is taken from its bulb, and mounted in a specially large clear bulb, some 10 cubic metres in diameter and 20 cubic metres long. Under these circumstances, the first two defects are met by the ageing; and the last is prevented, or considerably delayed, by mounting in the large bulb.

Such lamps, if only run for short periods, form valuable secondary standards. But, owing to the large negative temperature co-efficient of carbon, a comparatively small alteration of voltage causes considerable alteration in candle power. Hence, if the standard is to be kept right to 1 per cent., the power it absorbs must be adjusted to 4 per cent. This, therefore, necessitates the use of some very delicate potential measuring device—such as a potentiometer; and, further, it is practically imperative for the power to be supplied from secondary cells. Unless these precautions are taken, the results will be of doubtful value.

All the foregoing standards which depend for their light-giving power upon the incandescence of a solid substance may be used as ultimate standards of reference (with perhaps the exception of the Fleming lamp), and are designed to be constant and free from periodic and permanent changes, and to be reproducible from dimensions and specification. They are, however, not suitable (again excepting the Fleming lamp) as working standards, on the score that in most cases they require the use of delicate and complicated apparatus which is by no means portable.

Producing Light from Combustible Material.

On the other hand, if we employ the alternative method of producing light by burning some combustible material in air, or in an atmosphere of oxygen, we have an essentially portable light. Numerous researches have been made to obtain a suitable flame standard, with the result that it is invariably found that, to secure only approximate uniformity, we must have a fuel of definite chemical composition, and that this must be consumed under constant conditions. Of the numerous gas, oil, and candle flames, none absolutely complies with these conditions, the last of which is the most difficult to fulfil. Yet an enormous amount of expert attention has been paid to flame standards, which would perhaps have been more profitable if directed to the more scientific incandescent standards; for once a perfect incandescent standard is established, the study of the behaviour of flames is easy, and unification of standards is rendered possible.

Flame Standards.

At the very outset we have to face the difficulty that the light-giving properties of all flames are affected by the condition of the atmosphere; and consequently, if accurate results are to be obtained, we must determine the pressure, humidity, and percentage of carbon dioxide present in the air at the time of the measurements. These corrections are ignored by gas engineers, on the assumption that the flames they test are affected in the same manner as their standard. But with electric lamps, which are not so affected by atmospheric conditions, these corrections become appreciable, and three auxiliary determinations are necessary. The uncertainty of the primitive flame standard, the candle, led to the introduction of lamps consuming oils and combustible organic compounds rich in carbon, and an endeavour to produce standard gas-flames.

There are three conditions that the ideal flame-standard should fulfil—viz., (1) The fuel should have a definite chemical composition; and its purity should be capable of easy verification. (2) It must be consumed under easily controlled and well-defined conditions in a burner of definite dimensions. (3) Atmospheric changes should not affect the quality of the flame.

In this country the lamp most nearly fulfilling the above requirements is probably that devised and introduced by Mr. A. G. Vernon Harcourt in 1877. This lamp, which has passed through several modifications since its introduction, employs pentane as its standard fuel. This is the distillate yielded by light American petroleum after three fractional distillations, and subsequent treatment with sulphuric acid and caustic soda. The product has the chemical composition C_5H_{12}, and forms a mobile volatile liquid, giving off a highly inflammable vapour. The density of the liquid should not be less than ·6235 or greater than ·626 at 15° C. The density of gaseous pentane should lie between 36 and 38. Admixtures of hydrocarbons belonging to other groups (such as benzine or amylene) must be avoided. Their presence may be detected by the following test: 10 cc. of nitric acid of 1·32 specific gravity (made by diluting pure nitric acid with half its bulk of water) is introduced into a white glass-stoppered bottle. Add 1 cc. of a solution of potassium permanganate containing 0·1 gramme of permanganate in 200 cc. Add to these 50 cc. of the sample of pentane, and shake vigorously for five successive intervals of twenty seconds. If no hydrocarbons other than paraffins be present, the pink colour will still be distinct. If any other hydrocarbons be present, the pink colour will be discharged. The purity of the pentane is a very important point in these lamps, if the standard light is to be reproduced.

The Two Forms of the Harcourt Pentane Lamp.

Two forms of this lamp are in general use—viz., the portable 1-candle industrial form, sometimes called the Woodhouse and Rawson pattern, after the firm who made it in 1890 (fig. 5), and

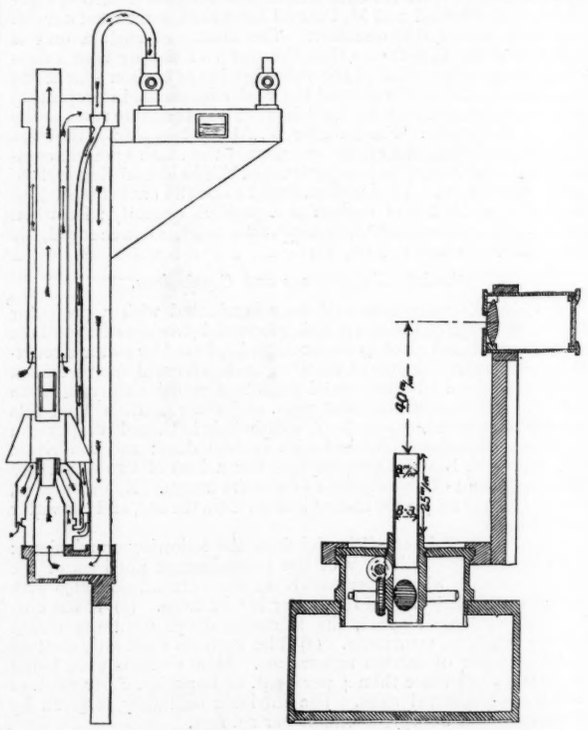


FIG. 5.—THE VERNON HARCOURT TEN-CANDLE STANDARD PENTANE LAMP.

FIG. 6.—THE HEFNER AMYL-ACETATE LAMP.

the most recent form of chimneyless 10-candle standard (fig. 6). In the former model, the pentane is raised to the burner by means of a circular wick. The wick-tube is surrounded by an outer tube of larger diameter, so constructed that a current of air passes up round the flame from below. Over the top of the outer tube, a metallic chimney is supported; the distance between the top of the outer tube and the bottom of the upper chimney being accurately set by means of a standard cylindrical steel

gauge. Thus all but a definite length of the flame is cut off by the chimney and outer tube. As it is important to regulate the flame height, two narrow slits are cut in the upper chimney; and the tip of the flame is regulated to be in the centre of these.

It was with this type of lamp that Libenthal made his investigations as to the effects of barometric pressure and humidity. He expressed his results in the following equations:

For variation of pressure—

$$\triangle L = \cdot 00049\ (H - 760).$$

Where $\triangle L$ is the variation in light corresponding to a barometric height of H millimetres.

For water vapour:

$$L = 1\cdot 232\ (1 - \cdot 0055 w).$$

Where w = the number of litres of water vapour per cubic metre of air—the formula holding good for 4 to 18 litres.

With regard to flame height, Mr. Harcourt* gives the following rule for correcting the height of the flame. The standard height of flame for 1 candle is 63·5 mm. at 30 inches barometric pressure. For every tenth of an inch above or below 30 inches, the flame must be set an equal number of fifths of a millimetre below or above 63·5 mm. Further, Professor Ayrton † has pointed out that considerable discrepancies occur in the dimensions of different examples of this lamp; and these differences will account for errors as large as 12·5 per cent. between measurements made with two standards. He further states that much depends upon the way the wick is treated; and the author's investigations on one of these lamps fully confirm this point—the charring at the top of the wick accounting for about 2 per cent. variation in the light. Another defect of the lamp is the heat-capacity of the metal parts—the lamp taking from half to three-quarters of an hour to reach a steady state.

I have described the performance of this type of lamp at some length, as it is even now largely used. In the more recent types of the Harcourt lamp, the wick is dispensed with, and the pentane vapour from the liquid pentane contained in the upper reservoir (fig. 6) descends by means of the flexible tube to the argand burner at the base, over which is a double metallic chimney. The air supplied to the centre of the burner is drawn up between these two chimneys, passes down the hollow pillar of the lamp, and thence to the centre of the burner. The chimney is adjusted so that its lower edge is 47 mm. from the steatite ring of the burner; a boxwood gauge being provided for setting the distance. A window is provided in the chimney, to adjust the height of the flame, which must be done with some exactitude.

The effects of variations in barometric pressure and humidity on this type of lamp have been investigated by Mr. C. C. Paterson, at the National Physical Laboratory, who has given the following formula:—

$$Cp = 10 + 0\cdot 66(10 - \epsilon) - \cdot 008(760 - b),$$

where ϵ is the humidity in litres per cubic metre, and b is the barometric height in millimetres.

These pentane lamps have not only proved valuable on account of their constancy, but also for the excellent white light they give. The flame is, however, very lambent, and therefore much affected by draughts. The author has, so far, been unable to obtain figures connecting the variation of the light of these standards with the amount of carbon dioxide present in the air; and from experience with the lamps it would seem that this is of considerable importance.

The Hefner Lamp.

The flame standard on the Continent and in America is the Hefner lamp. This lamp, which is a simple style of spirit-lamp, burning acetate of amyl, is an improvement on the early benzine lamps, among the first of which was the lamp of Eitner in 1877, which consumed benzine. With a view to eliminating errors due to the indefiniteness of the chemical composition and the unequal rates of combustion of the constituents of the fuels used, Hefner von Altenec investigated the effect of burning different liquids in these simple spirit-lamps, and came to the conclusion that amyl-acetate was the best substance to use. This fuel, which has an intense, agreeable odour has the chemical composition $CH_3{\cdot}COOC_5H_{11}$. It is prepared from amyl alcohol by distillation with crystallizable acetic acid and sulphuric acid. Its boiling point is 138°C. It is burnt in a lamp of the simplest construction; the burner consisting of a German silver tube, 8 mm. internal diameter, 15 mm. thick, and 25 mm. high. The fuel is raised to the top of this burner by a wick of cotton threads, just filling the tube without crowding. This wick should be maintained level with the top of the burner-tube; and if the reservoir is kept plentifully supplied with fuel, the surface of the wick should not char. The flame is tapering, and burns without a chimney. It should be regulated to a height of 40 mm. from the top of the burner to the top of the flame.

The excellent work of the Reichsanstalt, the German Gas Commission, and Libenthal have considerably enhanced the value of the lamp by determining its constants to a great degree of precision; and, as a result of these investigations, when lamps are constructed to strictly prescribed dimensions and materials, the illuminating power is reducible to within 2 per cent.‡ But C. H. Sharp,§ when comparing two Hefner lamps certified by the Reichsanstalt, found their mean difference was 1·2 per cent., although on two occasions this difference between the lamps was 5·2 and 3·9 per cent.

The effects of flame height, water vapour, carbon dioxide, and pressure have been investigated by Libenthal, and are expressed by the following formulæ:—

For water vapour:

$$L = 1\cdot 094\ (1 - 0053\ w),$$

Where w are the litres of water vapour per cubic metre.

For carbon dioxide:

$$L = 1\cdot 012\ (1 - 0071\ c),$$

Where c is the quantity of CO_2 in litres per cubic metre.

For variations in barometric pressure:

$$AL = 00011\ (H - 760).$$

And for flame height:

$$L = (1 + 025\ (h - 40)); \text{ or}$$
$$L = (1 + 030\ (40 - h)),$$

Where h is the actual height of the flame above or below 40 mm.

From the above it will be seen that the light of the Hefner lamp decreases 5 per cent. per litre of water vapour, and is correct at 8·8 litres per cubic metre. It also decreases about 0·7 per cent. per litre of carbon dioxide; being unity at 1·8 litres per cubic metre. A change of 1 mm. in the height of the flame causes 3 per cent. change in the light; and a change of 10 mm. pressure produces 0·1 per cent. Unless these corrections are applied to the lamp (particularly that of carbon dioxide), the results obtained with it will be considerably in error. In modern lamps, the Krüss optical flame-gauge is usually fitted. It consists of a lens mounted at one end of a short tube, which forms an image of the tip of the flame on a ground-glass screen at the other end of this tube; and across this screen a line is drawn, corresponding to the height, 40 mm. With this device the flame height can be adjusted with considerable exactitude.

Despite the facts that the constants of this flame are so well known, and that the lamp is easy to manipulate, is extremely compact, and not liable to get out of order, it has found but little favour in England. It is urged that the light is too red for ordinary work, and the unprotected flame is subject to draughts. Notwithstanding this, it may be justly claimed that the lamp forms one of the most useful and accurate flame standards employed at present.

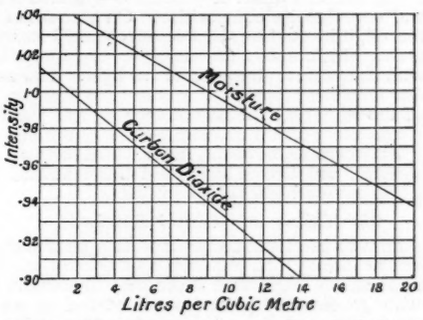


FIG. 7.—CURVES SHOWING THE INFLUENCE OF CARBON DIOXIDE AND MOISTURE ON THE FLAME OF THE HEFNER LAMP.

The somewhat large correction for carbon dioxide needs only applying when this impurity is present in very large or very small quantities, since the lamp gives the correct light when 1·66 litres of carbon dioxide are present; and this corresponds to a very unhealthy state of the atmosphere. For absolutely pure air, the light is only 1·2 per cent. higher (see fig. 7).

The light value of the lamp or Hefner unit is less than one English candle. The exact ratio of the Hefner unit to the candle is somewhat in dispute. Various determinations vary from 0·872 to 0·98; the most generally accepted value being 0·88.

Various Modifications of the Hefner Lamp.

In 1902, F. von Hefner-Altenec published an account of the various attempts to improve the Hefner lamp which had been made since its introduction in 1884. The German silver used for the wick-tube is liable to be of somewhat indefinite composition; but it was found that this did not materially affect the light, and no change is therefore made. Again, the amyl-acetate is not a pure chemical substance; and its extremely penetrating odour has proved an objection. L. Knorr has investigated possible alternatives, and the best appear to be acetylacetone, acetacetic ether, and isobutylacetate. The two former, however, are acid, and attack the metal parts of the lamp. Various mixtures of benzol and alcohol have been tried. It was found that these mixtures burned at a fairly uniform rate, and the light was more yellow. But, on the whole, the mixtures have not any great advantage.

The effect of impurities has been investigated with great care by Libenthal, who has found that they diminish the illuminating power to a slight extent. Amyl-alcohol may be present in considerable quantity without harmful results; 20 per cent. only lessening the light by 1·1 per cent. If the amyl-acetate is saturated with water, a diminution of only 0·5 per cent. is observable. Alcohol (methyl) seems to have the greatest effect. From the

* "Proceedings British Association," Aberdeen Meeting, 1885. † "Journal of Electrical Engineering," Vol. XXXII., p. 200. ‡ Professor E. L. Nicol's "International Congress of St. Louis," 1904. § "Transactions of the American Institution of Electrical Engineers," Vol. XIX., p. 1493.

above, it will be seen that the purity of the amyl-acetate is not of very great consequence if the light-giving power is considered; but impurities have a very marked effect in producing unsteadiness of the flame.

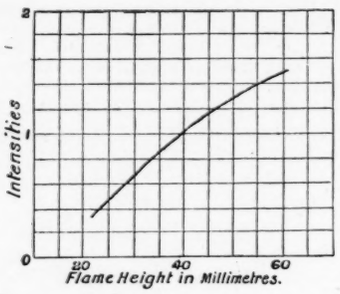


FIG. 8.—CURVE SHOWING THE INFLUENCE OF THE FLAME HEIGHT OF THE HEFNER LAMP.

The following method, due to Bannow, is suggested for verifying the purity of the fuel. The density of the liquid should lie between ·872 and ·876. The mixture of equal volumes of amyl-acetate and benzine should remain clear and liquid if amyl-alcohol or ethyl-hydrate be absent; or if carbon disulphide be substituted for the benzol, water will separate out in globules. A mixture of 1 cc. of amyl-acetate with 10 cc. of 90 per cent. alcohol and 10 cc. of water gives a clear liquid solution if toluene, &c., is absent. A drop of amyl-acetate should leave no greasy trace on white paper after evaporation if oils, tar, and other greasy materials are absent. M. Blondel* has constructed a modified Hefner lamp, making use of a chimney to prevent the air currents affecting the flame; the fuel used in the lamp being either amyl-acetate or crystallizable benzol and alcohol.

The Standard Carcel Lamp.

The French standard Carcel lamp has found but little favour among photometricians anywhere but in France, principally owing to the fact that the fuel which it consumes—purified rape-seed oil—is not of very definite composition. On account of the viscosity of the oil, it has to be raised by mechanical means to the top of the wick, which, unless the supply is copious, is liable to charring, with consequent alteration of the light. The nature of the wick also influences the light, as does also the rate of consumption of the oil. This should not vary beyond the limits of 38 to 46 grammes per hour; 42 grammes being the correct consumption. It is curious, however, that such experts as Fresnel, Dumas, Regnault, and Crova have used this standard in their researches, and spoken highly of its qualities.

The Methven and Giroud Standards.

Of suggestions to use illuminating gas as a photometric standard, probably those of John Methven and Giroud are the most important. Methven found that if ordinary illuminating gas be enriched with gasolene or pentane, and burned in an argand burner, a very constant light was produced; and by using a screen in front of the flame with an aperture of definite dimension, a very easily manipulated intermediate standard could be produced. Giroud aimed at producing a candle burner supplied by an automatically controlled supply of gas. Although both these suggestions are excellent on the score of convenience, they must (even for industrial use) be referred to some superior standard before their values can be ascertained with any exactitude; and therefore they only form sources of light which may be relied on to remain constant over fairly long periods.

Petroleum Lamp Standards.

In this connection few observers seem to realize that the ordinary petroleum lamp supplied with a round burner like the carcel lamp and a constricted glass chimney, forms a very constant source of light, and is quite equal to the Methven standard if used in the same way with a screen and aperture. The best kerosene as supplied in commerce differs but very little in its general properties; and if this fuel be burnt in such a lamp a very handy and easily managed source of light is produced. Weidemann, in 1881, and Hefner-Altenec have both spoken highly of such lamps; and the author has found only very small variations in its light (less than 1 per cent.) when burning for periods of several hours after the lamp is thoroughly warm.

Acetylene Gas Standards.

The use of acetylene as a standard flame has for a considerable time occupied the attention of photometricians. The definiteness of its chemical composition, the ease with which it can be made, and the intense whiteness of its flame, are all points strongly in its favour. But unfortunately no entirely satisfactory burner, which will give an absolutely reproducible flame, has up to the present been devised. M. Violle has been working at this problem since 1895, when he proposed to use a flame and screen of the Methven type. And many—notably Nicols, Sharp, Hartmann, and Féry—have done a considerable amount of work on the subject. Owing to the richness of the gas in carbon, it is necessary to burn it diluted with a certain amount of air; and if it were only possible to burn the proper mixture in a burner of definite dimensions, it would probably form a most suitable standard. But, on account of the highly explosive nature of the mixture, the orifice of the burner has to be so small that accuracy of workmanship cannot be guaranteed; and, further, the orifice itself is subject to clogging with graphitic carbon, and consequently there is a change in the proportions of air and acetylene. C. H. Sharp has burned acetylene in a mantle of oxygen, using a concentric burner; the acetylene passing out through the central orifice, and the supply of oxygen from the annular space between the tubes. This flame is very intense, but so sensitive to pressure changes as to render it unserviceable. Hartmann has studied mixtures of acetylene and hydrogen burning in air, and has shown that when the mixture is of equal volumes, the intensity is a maximum, and the flame is whiter than pure acetylene burning in air. Owing to the difference in the solubility of hydrogen and acetylene, it is not possible to store the mixture over water; but the gases may be supplied separately to the burner, providing proper precautions are taken to ensure an equal and even mixture.

General Conclusions.

Summarizing the foregoing review of light standards, we may draw the following conclusions: (1) That the ultimate standard of light will in all probability be a body in a definite state of incandescence. (2) That platinum seems to be the most suitable substance for the purpose. (3) That it will be preferable to use this substance at its point of solidification, providing this point can be maintained for a sufficient period, as the determination of any intermediate temperature involves the use of delicate and complicated auxiliary apparatus. (4) Flame standards are unsuitable as ultimate standards on account of atmospheric difficulty in burning the fuel under constant conditions. (5) That of flame standards, the modern forms of pentane lamps and the Hefner lamp are the best and most reliable, particularly the latter form of lamp, since its constants have been so carefully determined.

PHOTOMETERS.

From the production of a light standard, we turn to the methods of measuring intensity. Now this can only be accomplished by observing some phenomenon produced by the light itself. Since photometrically the only wave-lengths we are concerned with are those which lie between ·35 and ·8 μ—that is, the limits of the visible spectrum—and the intensity of the light expresses the sensation of brightness produced in the eye itself, our photometric measurements must ultimately be resolved into some form of visual measurement. Hence photometers, which are produced with a view to eliminating the eye and its vagaries, do not measure the intensity of the light at all unless they are first calibrated by some eye-method, and even then their indications may prove fallacious. I might, for instance, calculate the intensity of a beam of monochromatic light from a knowledge of the energy of vibration of the ether, providing I had some method of measuring the amplitude of vibration; but it is extremely doubtful whether the result so obtained, and the visual result, would be in agreement. The ultimate measuring instrument, therefore, is the eye; and the principle upon which all photometers is based is to present to the eye a surface, or two identical surfaces, upon which the light to be measured and the light from a standard source are falling, and to modify the standard beam until the eye pronounces the illuminations equal. Hence the photometric process consists of two essentials: (1) The production of two identical surfaces; or one surface, illuminated separately from each source. (2) The modification of the light from the standard source until equality is reached. As long as the lights are of the same tint, neither of these essentials is difficult to attain, and most photometers assume this in the first place.

Early Forms of Photometers.

It would be impossible to detail all the various forms of photometers which have been evolved; and I therefore propose to confine myself more to the principles involved, and describe only the more typical and modern. The earliest forms due to Bouguer and Foucault employed a translucent screen illuminated by the sources from behind, and having a thin dividing partition; the brightness of the two halves being adjusted. Lambert or Rumford illuminates an opaque white screen with both sources of light, and interpose an opaque rod into the crossed beams in such a way that each throws a shadow on to the white surface. Equality of the density of these shadows is then a measure of equality of intensity. This type of photometer has been exclusively used and advocated by Sir W. Abney in all his work upon colour measurement. But the author, in common with a great many other observers, has not found it of very great service, principally on account of its insensitiveness. Considerable difficulty is experienced in judging when the shadows are equally grey, and large personal errors are also possible.

One of the best methods of using the instrument is that suggested by Sir W. Abney—viz., to arrange the rod so that the two shadows just touch. Cover the screen with a black mask having a rectangular aperture in it over the position of the shadows. The indications of the instrument are then much more exact,

* "Eclairage Electrique," Vol. XVI., p. 317.

since the eye is not troubled with the light from the surrounding brightly illuminated surface. But even under these circumstances, the photometer, on the score of sensitiveness, is very inferior to most modern ones. Its one advantage is that stray light is of little or no consequence.

The Photoped.

In all the foregoing types, the sensitiveness is greatly increased by making the dividing line between the two surfaces as fine as possible. This feature is beautifully achieved in the photometer used by the Gas Referees and known as the photoped. In principle, it is really the inverse of the shadow photometer. A tube is closed at one end by a plate, in which a rectangular opening is cut. Inside this tube, a translucent screen is mounted in such a manner that its distance from the opening may be adjusted. If now two sources of light be set so that they make equal angles with the axis of this tube, they will each throw a patch of light on to the translucent screen; and if the screen be moved until the inner edges of the two patches touch, the dividing line may be made of infinite thinness. This is an excellent type of photometer, providing the inner screen is of the right translucency.

The Bunsen Type of Screen.

Probably the most commonly used type of screen is the bunsen. Here the outer parts of the screen are opaque and white, while the central portion is translucent. Hence, if illuminated from one side and viewed from the other, we should see a bright central spot on a dark ground; while if viewed from one side and illuminated equally on both sides, the surface would appear homogeneous. There are several methods of producing such screens. Originally they were simply grease spots on white paper; but more modern discs are constructed by piercing a hole (preferably with serrated edge) in an opaque card, and enclosing this between two translucent sheets of white material—such as parchmentized paper. The disc is usually mounted in a sighting-box with two mirrors, so placed that its sides may be viewed simultaneously, or, better, with Krüss prisms. The sensitiveness of the Bunsen disc depends to a large extent upon the selection of proper degree of translucency and upon the whiteness of the surfaces of the screen itself.

The Lummer and Brodhun Screen.

The beautiful optical modification of the bunsen screen introduced by Lummer and Brodhun in 1889, has considerably advanced photometric work. The arrangements of the head are shown in fig. 9. The light from the two sources under comparison falls upon the two sides of a pure white diffusing screen; and, by

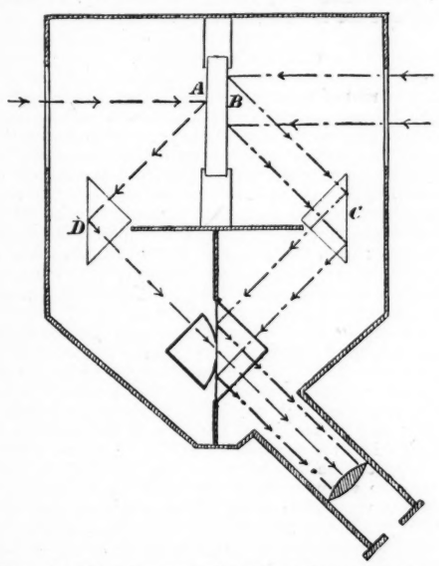


FIG. 9.—THE LUMMER-BRODHUN PHOTOMETER.

means of two right-angled prisms, the light from each of these surfaces is directed to the compound comparison prism. This consists of two right-angled prisms, with their longest faces in contact. One of these faces, however, is ground-back in such a way that the contact with the other prism is only made at a central spot. It will, therefore, at once be obvious that the light incident upon the surface A will be directly transmitted through the compound prism, while light falling upon B will be totally reflected. If now these two beams be received in a telescope, we shall see the central portion of the field illuminated by directly transmitted light surrounded by an annulus of light totally reflected.

The division between the two fields is practically an optical one; and hence the photometer ranks as one of the most sensitive. Indeed, I am strongly of opinion that there is no device that can compare with the photometer for sensitiveness even at very feeble illuminations. There is, however, one curious defect which seems to be present in all the examples of this instrument I have had an opportunity of examining. If balance is obtained between two sources of light with this photometer, and then the lights are reversed, it will be found that they no longer bear the same ratio to one another. M. Violle mentions this defect, and puts its value at 3 per cent.; but in some examples I have examined, it is considerably greater than this. M. Violle has attributed it to some hitherto unknown property of total reflection. But my experiments with a screen of this kind show that it is partly due to unequal scattering of light from the surfaces of the prisms C and D; while Dr. Drysdale has further suggested that the light coming from the white surface does not all reach the totally reflecting surface at the critical angle, and therefore some is transmitted. It is significant that the light is apparently weakened which is on the side that illuminates the annulus.

The Trotter Relief Photometer.

Mr. A. P. Trotter has devised a simple form of relief photometer (fig. 10), which consists of two screens of Bristol board which have had their glazed surfaces removed. These are set into a carrier in such a way that each receives illumination from one or other of the two sources, and reflects it through the sighting aperture. The foremost of the screens entirely fills the field of view, except that in its centre is punched a star-shaped hole through which the back screen may be seen. When the two screens are equally illuminated, the star-shaped aperture should apparently vanish. When using such a screen, however, one has considerable difficulty in getting the star to vanish, for it is practically impossible to reduce the edges of the star-shaped aperture to a mere line, and their surface is of a different character to the rest of the screen. The difficulty, however, is somewhat overcome, I find, by relaxing the accommodation of the eye, and thus throwing it out of focus. This, in fact, forms a very useful method of obtaining a balance with any photometer, particularly when the two sources are of slightly different tints. Another difficulty with the Trotter screen is the fact that two roughened white surfaces are continually exposed, and soon become soiled and discoloured. Even with the greatest care, frequent renewal of the screens is an absolute necessity.

The Joly Screen.

The simple little screen of Dr. Joly, of Dublin, forms an excellent contrast photometer. Here two blocks of translucent material—such as paraffin wax—are mounted together, with an opaque film between them. Light falling on their sides is diffused through them. There is, however, some difficulty in obtaining homogeneous and equally diffusing blocks.

Hitherto the only method of obtaining a balance has been by altering the distance of one or the other lights from the screen, and employing the law of inverse squares in the final calculation of the light. It, however, frequently happens that it is not possible to do this, or that the light to be measured is so intense as to render the length of bench necessary far too great. Other methods have therefore to be resorted to One of the simplest is that originally employed by Fox Talbot in 1834, and which has been extensively used by Sir W. Abney throughout his work on this subject. It consists of interposing in the path of the intense beam a rotating sector of variable aperture.

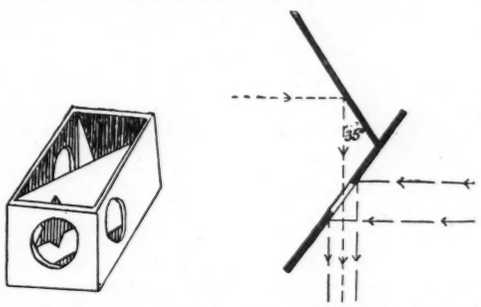


FIG. 10.—THE TROTTER PHOTOMETER.

If then ϕ is the angular opening of the sector; I the intensity falling on it; and I_x the intensity it transmits, it is stated that

$$I_x = I\frac{\phi}{360}.$$

Now the accuracy of this method has been repeatedly called in question, and many conflicting opinions and experiments have been advanced. Both Sir W. Abney and General Festing have stated that the sectors are accurate; Mr. Féry has stated they are accurate only for lights for the same colour;* Professor Fleming† has made experiments confirming their accuracy; while the experiments of Hurter and Driffield‡ have stated that, on account of the semi-shadow at the edges of the aperture, the above formula should be modified as follows:—

$$I_x = I\frac{\phi}{360} + c$$

Where c is a constant depending upon the position of lamp, sector,

* Cantor Lectures on "Photometry," 1894. † "Journal of the Institution of Electrical Engineers," Vol. XXXII., 1903. ‡ "Journal of the Photographical Society," June 20, 1890, p. 223.

and screen, and has but little effect at high intensities, but may rise to 100 per cent. for low ones. It has further been pointed out by M. Violle that, unless the flashes produced are less than 0·01 of a second, the results will be in error.

From experiments made by Mr. Bull and myself, we find that both the last-mentioned errors are present, except that Hurter and Driffield's constant should be preceded by a minus sign—that is, the light transmitted by the sectors is less than the theoretical amount by a constant per cent. depending upon the position of the lamp and sector. From one calibration, the constant c was 4 per cent.; while for another it amounted to 10 per cent. We further observed that as the angular aperture increased, the error became larger; but it could be reduced by increasing the speed. This is a verification of M. Violle's contention. Our investigations are not yet completed on this subject; but we feel sure that the sign in Hurter and Driffield's formula must be due to a clerical error. We have, however, no means of checking this point, as they merely give the formula without figures, and with but little comment.

It is interesting in this connection to note that Broca and Sulzer have shown that, for intermittent illumination, there is an inertia effect on the retina which gives the impression of greater brightness; while two observers in America have arrived at a conclusion which confirms our observations. There would, therefore, seem to be no doubt that the employment of sectors complicates the physiological effects. But it is possible that their employment in intense parallel beams, or in beams from a fairly distant source, is permissible if fairly large apertures are used. The observations were made with sectors accurately cut in solid discs, as it was found that the sector opening could not be accurately enough obtained from the adjustable form in use in the laboratory, and further, it was not possible to obtain the speed when using them. From the foregoing, we must therefore conclude that the sectors are not direct reading, and require callibrating for each setting of the apparatus, and are untrustworthy for apertures less than 10° and greater than 180° unless speed regulation is possible.

Ayrton and Perry have made use of a divergent or concave lens to produce the requisite weakening of the more intense beam; but the reduction of light so produced, if calculated from the known focal length and distance, does not take into account the light lost at the surface of the lens in back-reflection, and the minor effect of absorption. These may rise to a considerable value (8 per cent.), and Voller has suggested that, since the effect is principally on reflection, it should be compensated for by inserting in the standard beam a plate of glass of equivalent thickness.

Again, we may use diaphragms or stops in conjunction with convergent lenses forming real images of the luminous source, since the intensity of the image so formed depends upon the aperture of the lens, and is not altered either in size or position if the aperture be varied. This method has been used by Bouguer, Mascart, Crova, Comu, and others.

The employment of an absorbing wedge is another solution, and offers many advantages on the score of simplicity and accuracy, providing the light which is being modified is passed through a slit. Otherwise, the whole cross section will not be equally weakened. This defect may be overcome by employing two wedges of small angle so mounted as to slide one over the other; and hence the thickness may be uniformly varied. Finally, we may employ the property of polarized light.

If a ray of light be polarized by passing it through a Nicol prism, and the resulting beam be transmitted through a second and similar Nicol, whose principal section is at an angle with that of the first, the intensity of the emergent ray $Ix = I\cos^2\theta$, where I is the intensity of the beam emerging from the first Nicol. Thus, if the principal sections of the two Nicols be set at 90°, we have a total extinction, or, if parallel, complete transmission.

After a lengthy dissertation on polarizing photometers and hetrochromatic photometry, the author proceeds to notice the method of eliminating colour difficulties prepared in 1893 by Professor O. W. Rood. This method consists of alternately stimulating the retina with light reflected from each of the two sources under comparison and modifying one or both until flicker disappears from the field. His photometer consisted of a wedge whose surfaces could be alternately viewed by an oscillating lens or prism.

Flicker Photometers.

Several modifications of this type of photometer have been suggested. Thus Bechstein has alternately viewed the sides of a right-angled prism illuminated by the two sources of light by rotating a tilted and decentred lens before it; while in a further modification a 30° prism is rotated, and alternately reflects the light from each source into the eye-piece. Professor Whitman has proposed a simple form of flicker photometer, in which a fixed white surface is illuminated by one of the sources of light. This screen is set up at an angle of 60° to the axis of an observing telescope. In front of this fixed screen is placed a motor-driven sector (also of white card) illuminated from the second source of light. With this arrangement one obtains glimpses of the back card, and then the sector alternately; and the lights are adjusted until the flicker vanishes. Professor Fleming has modified the arrangement by splitting the sector up into a set of four sectors, like a Maltese cross. Krüss has evolved a form of flicker photometer which consists of a rotating disc. On the periphery are a set of mirrors mounted at 45° to the axis—each mirror reflecting light from the right and left alternately; while this principle has been employed in a much simpler fashion by Messrs. Simmance and Abady in this country. Their photometer consists of a disc of white material whose periphery is turned to form two equal conical surfaces. The axes of these cones are parallel to the axis of rotation; but are displaced on each side of it by equal amounts. The periphery is thus formed by two surfaces sloping at equal but opposite angles; and the separating ridge formed by their intersection crosses and re-crosses the field of view at each revolution.

It will be seen that in all the above flicker devices the object aimed at is to balance equal luminous sensations; and it would seem, theoretically, that the method cannot fail to be successful. Indeed, it will be found that for lights of the same (or nearly the same) tint, the methods are capable of yielding excellent results. Lauriol, investigating the matter, has given a speed of 6 to 8 revolutions per second for the Abady photometer. But he asserts that no certain results can be obtained with this instrument if the lights are of dissimilar colour, owing to complications due to physiological and speed phenomena.

The author has also made a number of comparisons with this photometer and obtained the following results: With lights which approximate to white, and which are, therefore, not of very dissimilar colour, the photometer run at a slow speed gives results which compare very favourably with those taken with an ordinary Bunsen screen. But the sensitiveness is less than that of a good Lummer-Brodhun head. With lights of dissimilar colours but of the same visual intensity, the photometer is much less sensitive, and the flicker reaches a minimum but never disappears; while for comparisons of a narrow band in the spectrum with white light the results are quite untrustworthy.

Messrs. Simmance and Abady have claimed that their photometer is independent of the Purkinge phenomena; but it is difficult to follow their arguments, since the photometer is essentially based upon the balance of two sensations, and there is but little doubt that for equal luminosities the red and blue sensations have different values. In this connection, however, Broca and Sulzer have shown that if a coloured light be allowed to act on the eye for successive brief periods, the brightness of the intermittent light is apparently increased—the blue being most affected, the red intermediate, and the green last. From this, they conclude that blue causes greatest retinal fatigue and green least.

Of photometers which aspire to be independent of the eye altogether, very little need be said; for, as has been mentioned before, light is for purposes of vision, and these photometers must find their original calibration by some visible means, and, like all calibrated instruments, they would require frequent checking if their indications are to be relied upon.

Chemical Photometers.

The employment of selenium, which alters its resistance when exposed to light, has not up to the present been entirely successful, while chemical photometers, which depend upon the combination or reduction of chemical substances under the action of light, are very uncertain in their indications, and are largely affected by ultra-violet light. It would, therefore, seem that a method is still wanting by which the luminous intensity of a coloured light may be determined if this quantity is differentiated from the visual intensity; and, further, that the visual intensity can be more exactly measured by a discrimination device for lights of widely different spectral quality than can their luminous intensity by any of the methods mentioned above.

It is interesting to note, in connection with the above, that Sir W. Abney has stated repeatedly that, using the sectors and the shadow photometer, he is able to measure the luminous intensity of two or three coloured patches from the spectrum in terms of white light from the same source and to combine them into a white patch; and he finds that the sum of the separate luminosities are equal to the luminosity of the resultant white patch to a surprising degree of accuracy. Mr. Bull and the author are endeavouring to repeat these results; but up to the present we have not been very successful, although the apparatus we are employing is practically identical with Sir W. Abney's.

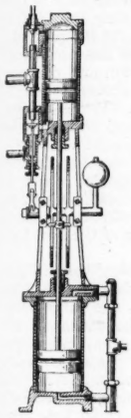
The above methods are all based upon the comparison of the general impression of brightness of the surface illuminated by the coloured beam. For the exact comparison of two luminous sources of different quality, we must resort to spectro-photometry, and compare the ratio of the intensity of the individual component rays one with the other. The process is, in consequence, a difficult and tedious one. In all cases the two sources of light are decomposed into their spectrum by means of some optical dispersive device, such as a prism train or a diffraction grating; and the two spectra are then compared in detail—the luminosity of the comparison spectrum being usually adjusted by crossed Nicols or by altering the apertures of the slit through which the light enters, the slit aperture being, of course, accurately measurable. Most of the modern instruments employ one or other of the above principles; but the subject is too intricate and highly specialized to allow of detailed treatment here.

In conclusion, although I cannot claim to have done more than bring before you the leading features of this subject, I trust that, in presenting them in a collected form, they may prove of service to those specially interested in this subject, and indicate directions in which special investigation would prove valuable.

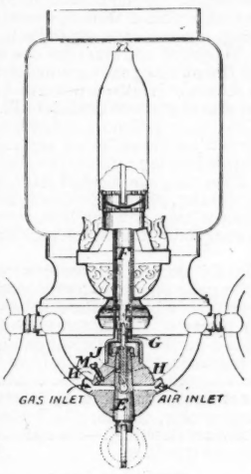
COMPRESSING AIR FOR HIGH-POWER INCANDESCENT LIGHTING.

Not for the first time, we have brought to our notice a system of high-pressure incandescent gas lighting in which there is an inversion of the general procedure—the air, instead of the gas, being supplied to the burners under pressure. The particular system now referred to is the property of the "Century" Light Company—a Massachusetts concern with its headquarters in Boston. At the present time, there is on this side a gentleman intimately interested in the Company; and he is making arrangements for exhibiting the apparatus, and demonstrating its efficiency, in London. In view of this, some details of the apparatus and its operation may be of interest; and we extract these from a description published in the "Scientific American."

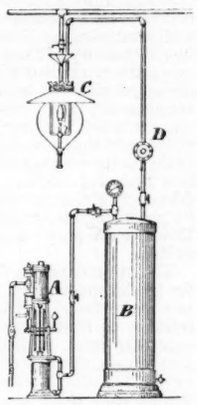
The air is compressed by means of a simple pump, which may be placed in the cellar or any other convenient place. It only occupies about one square foot of floor space, and is operated by the ordinary water power at, it is said, an expense that is insignificant. Looking at the diagrammatical representation of the system, the water supply is admitted alternately to opposite ends of the upper cylinder A of the pump, giving a reciprocating motion to the piston. This piston is connected by a rod with a piston in the air-cylinder; and the air compressed therein is forced into a galvanized iron tank B, whence it is fed through a small brass pipe to each lamp C. The action of the pump is automatic, and requires but little attention. The pressure is governed by a regulator D, which reduces the pressure to 3½ lbs.—the amount necessary to produce the maximum candle power in each burner.



Section of Pump for Compressing the Air.



The Burner.



Diagrammatic View of the New "Century" Lighting System.

The lamps used with the system vary in design to suit different tastes. The gas-supply and the air-supply pipes are both enclosed by a tube leading down to the main frame of the lamp. The gas passes down the right side of the lamp through the tubular frame, while the air passes down the left-hand side to a valve at the bottom of the lamp. A set-screw is threaded into the air-channel, just below the point where the air-pipe is connected to the lamp frame; and this provides an additional means for regulating the amount of air admitted to the lamp. The details of this valve and the burner will be clearly understood by reference to the sectional view. The valve plug E is formed with a central channel for the air supply, which enters the mixing-chamber F through a nipple G, while the gas supply branches and opens into the mixing-chamber through two ports—one on each side of the nipple G. The valve plug is also formed with an annular groove H near its upper end, from which a small channel J connects with one of the gas-channels leading into the mixing-chamber. This groove is also connected with the main gas-channel in the frame of the lamp, by means of a short branching passage-way K, which may be closed or opened to any desired extent by means of the set-screw M. The purpose of this is to provide a pilot-light. It will be observed that, when the valve-plug is turned, both the air supply and the gas supply are cut off. From the mixing-chamber the combined air and gas passes up to the burner, where it is ignited.

The flame, it is said, heats the mantle to a brilliant incandescence, producing a pure and steady white light. The incandescent mantle is protected by a large glass globe, which at its upper end supports a wide shade. This shade serves to reflect and diffuse the light. By means of the compressed air employed in this system, and the accurate regulation provided, it is possible (says our American contemporary) to maintain a temperature just high enough to produce an almost perfectly white incandescence without impairing the life of the mantle. One of the lamps, such as is described here, will yield 500-candle power with ordinary gas; and this light, it is stated, may be produced at the cost of one cent. per hour.

TEST OF AIR-LIFT PUMPING PLANT.

In a recent number of "Engineering Record," particulars were given of a test of air-lift pumping plant carried out in the irrigation works of the Redlands (Cal.) Water Company, with the view of determining its efficiency. The works supply water to about 1000 acres of land, practically all of which is set out in orange groves. The supply was formerly obtained from the Bear Valley irrigation system; but during three months in the summer this system was inadequate to furnish water, and deep wells were sunk to afford a supply to cover the deficiency. The part of the works at the pumping plant before the installation of the air-lift system embraced four wells from 415 to 570 feet deep, a boiler and engine house, a receiving basin, and a storage reservoir. One of the wells was operated by a centrifugal pump driven by an electric motor, one by a plunger pump driven by an auxiliary steam-engine, the third by a centrifugal pump similarly driven, while the fourth was not in use. It was decided to replace these pumps and machinery by some system which would be adapted to the varying heights of the ground-water level, and at the same time could be applied from one plant to all four wells, which are from 50 to 150 feet from the central point.

The wells are sunk through strata of clay and gravel which are very irregular in formation; the clay being encountered in pockets of varying thickness, and at various elevations in the different wells. It was determined that the greater part of the supply was drawn from the upper part of the wells; and when the three that were in operation were being drawn upon at the usual rate, the ground-water level, which usually stood within about 45 feet of the surface, was drawn down from 20 to 25 feet. A drainage area of 1·54 square miles is immediately tributary to the wells; and it was considered that, if this local drainage basin alone supplies the wells, the present rate of extraction would lower the water plane. The depth of the ground water below the surface and the draft upon it is also dependent to a considerable extent upon the yearly variation of rainfall. Any system to be installed was required to be sufficiently flexible to meet the varying heights of suction lift.

The installation of a reciprocating steam pumping plant was not feasible, as the sinking of a large pump-shaft connected to the various wells by tunnels was held to be comparatively impracticable, owing to the gravelly nature of the soil and to the proximity of the tunnels to the storage reservoir. There was also liability, in case the shaft was sunk and the tunnels run, of the water plane afterwards dropping below the proper suction lift of the pump. In this event, though the shaft and pump might be lowered, this could not be conveniently done in the case of the tunnels.

While electrically-driven centrifugal pumps are adapted to conditions similar to those of this plant, the local high cost of electric power prevented their installation. Power cost 2·5 c. per horse-power-hour for the motor already in operation; making the cost per water horse-power-hour between 5 c. and 7 c., depending on the efficiency of the pump. The separate engine required at each well by steam-driven centrifugal pumps was undesirable; and the high cost of fuel for a gas-engine plant made such an installation impracticable.

An air-lift system operated by a central compressor plant was considered to afford the most economical means of meeting the situation; so the wells were fitted with air and discharge pipes, and a complete compressor plant installed. The discharge-pipes vary from 4 to 7 inches in diameter, and extend from 306 to 360 feet down in the wells. The air-pipes, from 1¼ to 2 inches in diameter, reach down from 300 to 312 feet inside the discharge-pipes. The plant is placed in a 40 ft. by 46 ft., one-storey brick engine-house, with a corrugated iron roof. A 16 ft. by 5 ft. 6 in. oil-burning horizontal tubular boiler supplies steam to the air-compressor. It is a cross-compound Corliss compressor, with a 13-inch high-pressure steam-cylinder, a 14-inch high-pressure air-cylinder, a 26-inch low-pressure steam-cylinder, and a 22-inch low-pressure air-cylinder, all with a 30-inch stroke. The machine was designed to develop 190 indicated horse power when running at 85 revolutions per minute and one-quarter cut-off; steam being supplied at 125 lbs., and the engine operating condensing. Under the same conditions, the compressor has a guaranteed capacity of 1124 cubic feet of free air per minute compressed to 125 lbs., which is equivalent to 938·83 cubic feet per minute when the compressor is operating at 71 revolutions per minute, the normal rate of operation. The air-receiver is 3 feet diameter, and 8 feet long, with shell plates ¼ inch thick and heads ⅜ inch thick.

A 2½ in. by 4 in. triplex pump and a 4½ in. by 3 in. by 4 in. duplex pump furnish water to the boiler. The surface condenser is placed in a compartment beside the receiving basin. The wells discharge into this compartment, and the water flows from it over a weir to the basin. The condenser consists of small brass pipes with about 300 square feet of cooling surface; and, as it is always submerged when the plant is in operation, it forms a surface condenser without the usual cast-iron shell. A 6½ in. by 10 in. belt-driven vacuum pump is operated in connection with it. An enclosed exhaust-steam feed-water heater is placed in the exhaust main of the engine, and a hot well is also provided. The boiler is placed on concrete settings, and all the machinery was set on concrete foundations.

The test was conducted for 48 hours a few days after the

machinery was in position, with normal conditions of operation; the object of the test being to determine the amount of fuel used in each 24 hours when lifting and discharging definite quantities of water, and not drawing the water plane below certain elevations. The engine was run at 71 revolutions per minute; but towards the end of the test the speed was increased to 76 revolutions per minute for 33 minutes, with a corresponding increase in flow of about 100 gallons per minute. Crude Californian oil was used in the burners under the boilers. The quantity of oil consumed was measured by noting the fall in two large storage tanks, the capacity of which had been accurately determined. The flow of water was measured by a weir in the concrete wall between the discharge compartment and the receiving basin, and checked by noting the height of water in the basin—the quantity per foot of depth in it having been previously obtained.

The following table gives the results of the test; only the maximum, minimum, and mean values of 48 hourly observations being given. As may be seen from the table, the range of values in all cases was comparatively slight; the arrangement of the plant permitting unusually uniform conditions to be maintained.

	Maximum.	Mean of 48 Hourly Observations.	Minimum.
Pressure—			
Boiler . . . . lbs. per sq. in.	150·0	146·70	142·0
Air-compressor gauge ,, ,,	94·0	90·98	85·0
Steam in receiver . ,, ,,	14·5	12·45	11·0
Air intercooler . . ,, ,,	20 0	19·30	19·0
Vacuum . . . . . in. of mercury	25·2	24·83	24·5
Well No. 1—			
Air pressure . . lbs. per sq. in.	89·0	87·40	84·0
Water below surface . . . feet	109·0	101·44	98·0
Well No. 2—			
Air pressure . . lbs. per sq. in.	95·0	93·60	92·0
Water below surface . . . feet	93 0	90·37	86·0
Well No. 3—			
Air pressure . . lbs. per sq. in.	90·0	87·03	85·0
Water below surface . . . feet	116·0	110·67	99·0
Well No. 4—			
Air pressure . . lbs. per sq. in.	86·0	85·40	84·0
Water below surface . . . feet	105·0	102·20	101·0
Fuel consumption . . bbl. per 24 hrs.	17·2	16·30	15·7

Rate of pumping, gallons per 24 hours—Maximum, 3,280,824; mean of 48 hourly observations, 3,157,622; minimum, 3,131,395.

REGISTER OF PATENTS.

Incandescent Mantles.—Valeriola, E. de, and Sepulchre, E., of Brussels, and Mceller, J., of Victoria Street, S.W. No. 14,288; June 25, 1904.

This invention relates to an improvement in the manufacture of mantles for incandescent gas lighting, "whereby a superior mantle of greater resistance, flexibility, and elasticity, and capable of maintaining its form and illuminating power, is obtained, and its manufacture is rendered easy and economical."

Two distinct methods are employed. According to the first, the threads destined for the manufacturing of the mantles are impregnated with a solution of illuminating substances, especially nitrates; the degree of the concentration of the solutions, the method, and the time of the impregnation varying according to the thickness and the nature of the threads. When impregnated, the threads are squeezed and dried as rapidly and completely as possible. After drying, the threads are exposed during a comparatively short time to the action of ammoniacal vapours. By this operation a part of the illuminating nitrates is transformed into hydrated oxides, but about one half of the nitrates absorbed by the threads is not attacked. Thus a thread is produced the core of which is impregnated by illuminating nitrates and covered by an impermeable envelope consisting of the hydrated oxides.

After having been exposed to the air for a few moments, the threads are washed with distilled water for the purpose of eliminating the ammonia nitrates which have been formed by the partial transformation of the illuminating salts into oxides. And after being dried again, the threads are made into tissues for the manufacture of the mantles.

It has been said that the action of the ammoniated vapours must be limited to the transforming of the superficial parts of the illuminating nitrate into hydrated oxides. It is this point particularly which forms the characteristic part of the process. The results of the partial transformation are: 1. Before the incinerating process, only hydrated oxides and illuminating nitrates remain on the threads. 2. The quantity of the salts which are to be transformed from nitrates into oxides by incineration is greatly reduced. 3. The explosions resulting from the direct contact of the flame with the nitrates are completely avoided.

It follows, say the patentees, that this process simplifies considerably the incinerating operation, and renders the manufacture of the mantle more regular. Under the action of the flame, the oxides absorb a corresponding quantity of the salts in the state of nitrates and unite closely all the oxide molecules which have been set free by the transformation of the nitrates. Therefore at the incineration, a fusion and union is produced between the oxide molecules contained in the nitrates and those which were already transformed into hydrated oxides. The gases resulting from the transformation of the salts are produced slowly and without explosion; and thus there is obtained an intimate and regular union of the oxide molecules, which fix themselves in the form of the body itself and neither produce crystallization nor vitrification. The threads obtained look like half transparent glass strings—not fused together at the points where the meshes join. The presence of both illuminating nitrates and hydrated oxides is, therefore, absolutely required; and for this reason it is necessary to limit the transformation of the nitrates and also the action of the ammoniacal vapours, and likewise a subsequent washing is essential for the purpose of eliminating the ammonia nitrates, which might cause the destruction of the fibre if the mantle were incinerated before washing them away.

If, on the other hand, only nitrates are present, the fibres of the body contain as oxides at most 40 to 48 per cent. of the salts used. Therefore it is indispensable, for the purpose of transforming the salts into oxides, to eliminate the dissolvents entering into the composition of the nitrates for about 52 to 60 per cent. This operation, it is remarked, cannot be executed without producing a number of explosions of gases, whereby the perfect cohesion of the molecules is greatly impaired. The violent fusion accompanied by explosions produces a hollow, fragile, and swollen structure "having the appearance of a chain of which the oxide molecules are only slightly united together." These molecules disassociate partly under the action of the flame of the bunsen burner; and the mantles thus manufactured shrink when being used, lack in solidity, and lose their illuminating power.

On the other hand, when mostly oxides are present, the cells disappear when the mantle is burnt off, and the oxides which are set free unite completely and absolutely. But by employing this new method of manufacture, the incinerating of the mantle is said to cause a reduction of the volume and surface until the oxide molecules are absolutely united; and thus "the structure of the mantle cannot be impaired by the reducing and destructive action of the flame." Therefore the mantle is perfectly and slowly incinerated without any of the above-mentioned incidents; and the illuminating bodies consist of "full, pliable, and resisting threads formed by oxides that reproduce absolutely in the form of a skeleton fibres which served for the manufacture of the mantle or illuminating bodies."

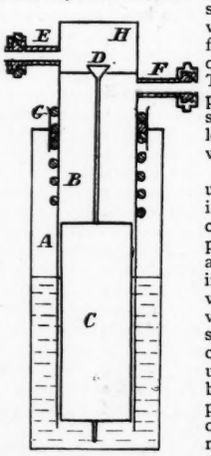
The same method of treatment can be applied to impregnated and knitted or woven cotton or other fabrics; the special treatment described beginning with the drying after impregnation and then continuing the treatment with ammonia vapour, washing, drying, and then incinerating as described.

Similar results are obtained if the same methods are applied in the manufacture of mantles with artificial threads containing the illuminating salts before spinning. In this case, the following is the process: In the quantity of alcohol required and ether (or one of these products only), the nitrates of the illuminating salts are dissolved, and the concentrated solution thus obtained is mixed with the substances which are generally used for the manufacture of artificial silk. When leaving the machines, the threads thus obtained are dried, and immediately afterwards they are exposed to the action of ammoniacal vapours—again for the purpose of transforming a part of the illuminating nitrates into hydrated oxides. Then they are washed with distilled water to take away the ammonia nitrates, afterwards dried, knitted, or formed for producing an incandescent body, and finally incinerated by a bunsen flame for the purpose of completing the transformation of the salts into oxides.

The patentees claim that this process is more economical than others, for (*a*) the quantity of the necessary salts for producing the mantles can be reduced considerably without diminishing the durability, solidity, or illuminating power of the mantle; (*b*) the action of the ammonia being limited to a partial transformation of the illuminating compounds, the use of ammonia baths, which have to be constantly renewed as they become charged with nitrates, is avoided. Also that the threads or tissues, not being any more hydroscopic, can be kept indefinitely and are transportable, and may be incinerated long after being prepared in the manner described—the state of the atmosphere having no influence upon the qualities.

Gas Governor or Regulator.—Claughtons (Leeds), Limited, and Austin, E., of Leeds. No. 3880; Feb. 24, 1905.

The means suggested whereby the pressure of gas or air may be automatically reduced, and maintained at such reduced pressure, will be seen by referring to the illustration. A is a vessel containing glycerine or any suitable fluid; and B, an inner vessel which has a free outlet at the bottom, opening into the vessel A. The pipe E is the inlet for gas or air, and the pipe F the outlet leading to the point of consumption. H is an air-chamber, with an outlet into the vessel B, controlled by the valve D, which is attached to the float C.



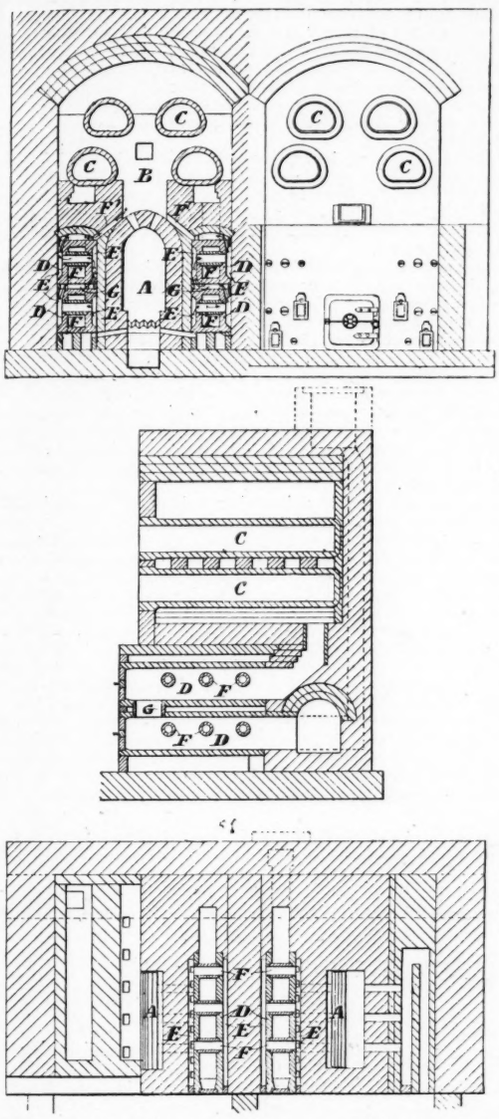
Gas, admitted through the pipe E into the upper chamber H, passes through the valve D into the vessel B, and from thence is discharged through the pipe F. Any initial pressure on the gas of air passing through the apparatus displaces the liquid in the vessel B into the vessel A. As the liquid lowers in the vessel B, it carries with it the float C and the valve D, thus cutting off any excess in the supply of gas or air that would tend to increase the pressure in the vessel B. The uniform pressure in the vessel B is determined by the amount of liquid which must be displaced before the valve D commences to cut off the passage of gas or air. The vessel A is made detachable and adjustable, and the normal level of the liquid in the vessel B is determined by the position of vessel A in relation to vessel B. On the top of vessel A is fixed a sleeve G, which carries a female thread engaging a male thread on the outside of vessel B. By this means, any desired upward or downward adjustment is readily effected.

Regenerative Flues for Gas-Retort Ovens.—Brown, J., of Hamilton, N.B. No. 18,796; Aug. 31, 1904.

This invention has for its object to so construct the flues for conveying the hot gases that "the secondary air will be more effectively distributed by splitting it into small streams, and more efficiently

heated, and that liability of short-circuiting or leakage of gases or combustion products into the air-passages may be avoided."

Apart from the regenerative flues, the retort-furnace is of ordinary formation, comprising a producer chamber A and combustion chamber B, in which are set the retorts C. The flues on each side of the producer are formed of conduits D, made up of fire-clay material of square, oblong, octagonal, rectangular, or like section, placed so as to leave spaces E between them and the side walls of the flues. The conduits are fitted with small tubes F extending transversely of the conduits horizontally (as shown), vertically, or at an inclination, or it may be longitudinally of the conduits; so that while the hot gases traverse the



conduits D, the secondary air which enters regulated openings passes through the tubes F, and thence across one conduit to those in the conduit above, as indicated by the arrows, becoming highly heated in its course. Or the air may be carried through the conduits D and the gases through the cross-tubes F. These cross-tubes F are arranged to deliver the highly-heated supply of secondary air through the ports F^1 for combustion of the gases passing from the producer A through ports into the combustion chamber B around the retorts C.

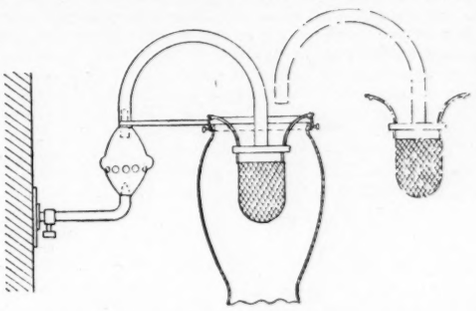
The conduits D are preferably made in such lengths that there is no joint in the length of the flue; and "as no single part is more liable than another to give way, the risk of short-circuiting is avoided." The conduits at the front ends are easy of access for inspection and cleaning.

The soles of the conduits D are preferably made of a width approximately equal to the width of the flue-space usually formed between the walls of the brickwork on each side of the producer chamber, so that when the fire-clay conduits are superposed the space is made up of the conduits D and flue-channels E formed by the parts of the space unoccupied by the conduits. The fire-clay conduits, where they rest upon each other near their ends, are formed with orifices G, which serve to connect each fire-clay conduit D to that above or below it; the connecting orifices G being formed at opposite ends in the alternate conduits, so that a continuous zig-zag flue is formed.

Inverted Incandescent Gas-Fittings.—Negal, M., of Praed Street, Paddington, W. No. 3928; Feb. 24, 1905.

This invention has for its object to facilitate the removal of inverted incandescent gas-fittings for the purpose of renewing the mantle, cleaning, or repairing.

The patentee attaches to the ordinary gas-bracket a chamber wherein the air is drawn from the atmosphere to mix with the gas, which then passes to the burner. The upper part of the mixing-chamber is provided with an elongated neck, so as to form a long joint for the inverted fitting proper, which is secured to the bracket by fitting it comparatively loosely over the neck. The fitting comprises a metal tube, preferably curved, terminating at its free extremity in the burner, which is fitted with any suitable holder. Removably secured to the mixing-chamber are two arms or supports, extending outwardly and carrying the shade gallery or ring, which surrounds the inverted gas

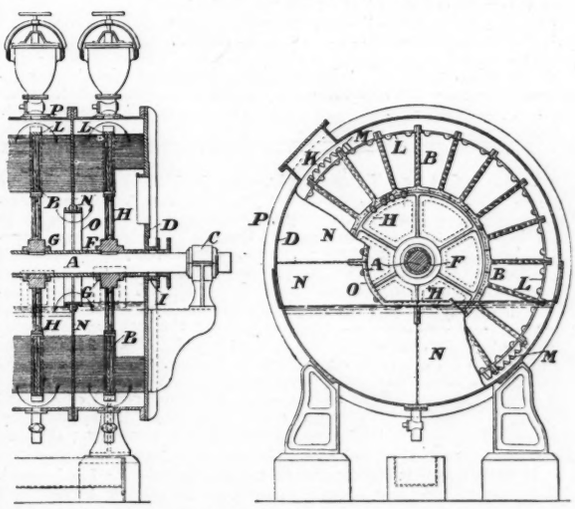


tube and mantle. In order to ensure that the burner is situated concentrically with the gallery, the curved tube has guides or stays, bent at the ends in such a manner that they rest upon the top of the gallery and bear loosely against the inner sides of it. Thus the fitting as a whole, may be said to consist of two portions—the "burner" portion and the "shade carrier;" and these two are arranged in such a manner that, when it is desired to renew the mantle or clean the burner, it is only necessary to raise the curved tube from the mixing-chamber neck, when the burner can be withdrawn entirely from the shade ring.

Washing and Scrubbing Gases.—Holmes, E. D., of Huddersfield. No. 5761; March 18, 1905.

This invention relates to the apparatus described in patents No. 5113 of 1895 and No. 7364 of 1902, with the object of preventing such parts as were made of steel being attacked under certain conditions by some of the substances which go into solution in the washing liquid, by giving them a protecting covering of cast iron, which is practically not liable to attack by any salts or acids present in the solution or gas.

The shaft A, which carries the brush segments B, and which is journalled in brackets C on the ends of the casing D, is of steel or wrought iron; but the exposed parts of the shaft are enclosed by sleeves of cast iron F, the ends of which are let into adjacent bosses G of the brush-carrier discs H, and are jointed to it by red lead or other suitable cement. The two end sleeves are formed integrally with, or fixed to, the end bosses G, and extend into the stuffing-boxes I in the end plates of the casing, which are closed by packing glands. The brush-carriers are bolted to the carrier wheels or discs H, and are constructed in segments, which enable them to be removed or replaced individually through the bonneted opening K in the casing. These segmental carriers are stiffened by segmental stays or rim portions L,

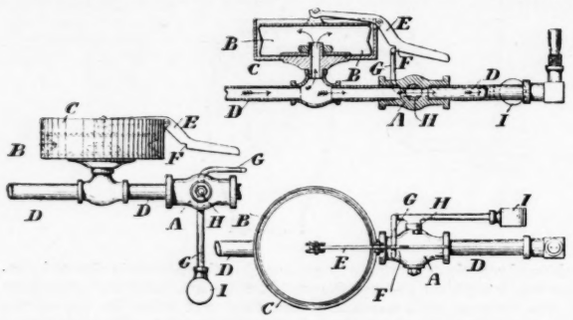


secured at the outer ends of the carrier-arms, which also secure the brush segments B when they have been slid into position in the carriers. Formed integrally with the rim stays, or secured thereto, is a set of obliquely arranged tooth-shaped projections M, by which the circulation of the cleansing liquid in the cleansing chambers is assisted. The partitions, which sub-divide the casing into a series of cleansing chambers through which the gas to be cleansed is passed in series, consist of a number of cast-iron annular segment discs N, flanged at their inner edges and secured round their outer peripheries between the flanged segment walls P of the casing. The segment discs are preferably dovetailed into each other, and are secured at their inner peripheries by flanged rings O.

Automatic Closing of Gas-Bracket Taps.—Birch, W., of Manchester. No. 8867; April 27, 1905.

This invention consists in providing the gas-bracket externally with a bag or bellows, or diaphragm, adapted to be inflated by the pressure of gas from the meter, and when relieved of such pressure (when the meter-tap has been turned off) to automatically close through suitable connections the bracket-tap.

A side view, longitudinal section, and plan of a gas-bracket is given to show one embodiment of the invention. In the rear of the tap A is a bag or bellows B, secured in a casing C on the top of a T-piece inserted into the gas-pipe D. To the casing is fulcrumed a lever E rearwardly pivotally connected with the top of the bag or bellows, and forwardly having a catch F adapted to operate a weighted lever G secured upon



the tap-plug H. Before turning on the meter-tap, the bracket-tap A remains closed, and its lever F is in the first position. When the meter-tap has been turned on, the gas fills the bag or bellows, and thereby raises the end of the lever E connected with it. When it is desired to light the gas, the tap A is turned by its lever G, and the rear end of the latter is thereby brought behind the catch F of the lever E, which then causes the tap to remain open. When the meter-tap is closed and the supply of gas cut off, the bag or bellows collapses and causes the lever E to release the lever G, and thereby the weight I on the latter to close the tap.

APPLICATIONS FOR LETTERS PATENT.

12,208.—Rivett, F., and Oldham, S., "Burners for gassing yarn." June 13.

12,251.—Kiderlen, A. E., "Gas-generator." June 13.

12,257.—Arundel, H. B., and Higginson, J., Jun., "Burners for gassing yarn." June 13.

12,289.—Woodall, H. W., and Duckham, A. M'D., "Vertical retorts." June 13.

12,331-2.—Fletcher, Russell, and Co., Ltd., and Neil, A. & W. R., "Gas-cookers." June 14.

12,357.—Croft, J. H., and Collins, J., "Incandescent burners." June 14.

12,370.—Crozier, D. J., "Straight-way valves." June 14.

12,388.—Bingham, C., "Oxy-acetylene burners." June 15.

12,392.—Rose, A., and Bellamy, W., "Holders for inverted mantles." June 15.

12,408.—Watson, J., "Gas-iron." June 15.

12,563.—Wilson, L., "Gas-producers." June 17.

12,577.—Maschinenfabrik Grevenbroick, "Gas-turbines." June 17.

12,605.—Lake, H. H., "Dirt-retainers for gas-nozzles." A communication from the Deutsche Gasglülicht Aktiengesellschaft (Auer gesellschaft). June 17.

Birkdale Gas and Water Supply.—Mr. J. F. Keeley, Clerk to the Birkdale Urban District Council, has just compiled his annual statement with regard to the gas supply. He states that the gas-mains in the district are owned by the District Council; the Southport Corporation supplying the gas at 3s. 2d. per 1000 cubic feet, less 5 per cent. if paid within a month. The Council pay the Corporation 2s. 9d. net per 1000 cubic feet for gas used for public lighting. There are 425 one-light, 43 two-light, and 2 three-light incandescent street-lamps in the district. The Southport Corporation pay for the right of supplying Birkdale with gas, and for the use of the Council's mains, 8d. per 1000 cubic feet on the gas used for domestic purposes. Water is supplied by the Southport, Birkdale, and West Lancashire Water Board; and the charges are as follows: On a gross estimated rental of £20 and under, 7½ per cent.; between £20 and £40, 7 per cent.; between £40 and £60, 6½ per cent.; between £60 and £80, 6 per cent.; between £80 and £100, 5½ per cent.; and £100 and over, 5 per cent.

Profit Estimates at Leeds.—In connection with the Leeds municipal budget, estimates were submitted by Mr. J. H. Henry, at a special meeting of the Leeds City Council last Wednesday, of the profits likely to be realized from this year's operations of the trading undertakings. The figures were as follows: Tramways, £52,000; gas, £18,000; and water-works, £11,000—a total of £81,000. Mr. Henry added that he knew the possibilities were that the Gas Committee would, under the new Consolidation Act, reduce the candle power from 18 to 16. He could not say he was in love with the proposal; but if they used these powers, a pledge had been given that the moment the illuminating power was reduced, the price would be lowered. The Gas Committee promised the profit named, if they were not unduly harassed in the matter of selling price, and also on the subject of the abolition of the unfair charges on automatic meters. For various reasons the Water Committee had found their income considerably reduced, and they could not promise more than the amount he had stated.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

The Testing Question.

Sir,—In your editorial of the 20th inst., you prominently refer to my improved "London" argand as an available burner for testing 14-candle gas. You ask: "What is likely to be the result of the substitution" of this burner "for the method prescribed by the South Metropolitan Act of 1900," and at the same time provide an answer from the report by Messrs. Carpenter, Hunt, and Jones—giving certain figures. Now I should like to point out that these figures in no way answer the problem, because it is quite clear that the method of using my 1902 burner is not really understood; and also, that the advantage ascribed to the "Wandsworth" burner over the "London" argand is much exaggerated.

In the first place, my burner is not intended to be used for burning coal gas at 5 cubic feet per hour, but at such a rate of consumption as will give a 14-candle flame in a 5-inch by 1⅛-inch diameter chimney; the result being calculated to 5 cubic feet in the same way as is done by the present official method of maintaining a 16-candle flame in the "London" argand.

At best, the "Wandsworth" burner with its 7-inch chimney (any other chimney is useless) yields occasionally a tenth of a candle more than mine (but more often the results are alike); while the "Wandsworth" burner cannot possibly produce with 14·23-candle gas 1·17 candles in advance of the prescribed 16-candle method in the "London" argand, but only a good half-candle. My object at the time of improving on the supposed, and then generally accepted, "best light-developing" "London" burner was to show that the 16-candle flame basis did not develop the "greatest amount of light" that was stored up in the gas, and also to prove that a certain amount of light really was masked by a degree of over-aëration, and of which we were all ignorant three years ago. It is not necessary to burn a large quantity of gas in order to develop its light.

We have now arrived at a time when a change of burner is desirable and necessary; but I fail to see the necessity for "the adoption of separate burners for each quality of gas" when we have a 24-hole (or 15 if required) burner suitable and capable of developing the light from any gas and alike suitable for use by the consumer. In order, however, to render the system of testing uniform with such a burner, the gas should be consumed so as to maintain a fairly uniform volume of flame of (say) 3½ inches in a 5-inch by 1⅛-inch chimney. This will give uniform results for all gases.

Or, again, if more desirable to maintain a flame-value test (and there is very much to recommend this system) as 14 candles and 16 candles, employ a 5-inch and a 6-inch by 1⅛-inch chimney respectively on the 1904 "Grafton" burner, and which could be used on the present official table photometer—the lights consequently being fixed. Such methods would treat the gases fairly, and would be a distinct gain and advantage to the consumer, while being fair to the gas companies, because the burner would develop 14-candle gas equally in *pro ratâ* with 16-candle gas.

June 22, 1905. W. Grafton.

PARLIAMENTARY INTELLIGENCE.

ADMINISTRATIVE COUNTY OF LONDON AND DISTRICT ELECTRICITY BILL.

Standing Orders Not Complied With.

The Administrative County of London and District Electric Power Company's Bill, having been read a first time in the House of Commons, was referred to the Examiners of Standing Orders. The South Metropolitan Gas Company presented a memorial complaining of non-compliance with the Standing Orders; and a discussion on the memorial took place last Thursday, before Mr. Campion, the Senior Examiner.

The point raised by the South Metropolitan Company was as follows: When the Bill was introduced into the House of Lords, it contained provisions for the compulsory acquisition of lands acquired by the Gas Company under an Act of 1902. In the session of 1900, the Gas Company obtained powers to make a railway to connect with a branch line of the South-Eastern Railway. The lands which the Gas Company had acquired under the powers of the Act of 1902, were the lands over which the Electricity Company sought powers of compulsory purchase. The Gas Company objected to the acquisition of their land or any part of it; and during the course of the discussion before the Committee, it was stated that the Electricity Company did not wish to acquire lands if the Gas Company would give them running powers and facilities over their line, to get access to the South-Eastern Railway. The Gas Company objected to do this. When clauses were being discussed, the promoters brought up one which was to the effect that if the Gas Company constructed the railway authorized by the Act of 1900 within six months from the date of the passing of the Electricity Company's Act, the Electricity Company should not acquire any part of their land; and in the event of the railway being constructed, the Gas Company were to afford all reasonable facilities and running powers to the Electricity Company and to the South-Eastern Railway Company. This substantially was the point on which the Gas Company memorialized, on the ground that no notice had been served on them as required by the Standing Orders relating to compulsory running powers, and that no notice of the intention to apply for running powers had been published in the "London Gazette" or the local newspapers.

Mr. H. R. Cripps appeared for the Gas Company, and argued the technicalities raised in their memorial; Mr. John Kennedy, the Agent for the Bill, replying on behalf of the promoters. The room was then cleared; and upon the parties being re-admitted,

Mr. Campion (with whom had sat Mr. Symons Jeune) stated that he could not uphold Mr. Kennedy's contention that the greater power included the lesser power; and he would report a non-compliance with the Standing Orders in so far as no notice for compulsory running powers had been published in the "London Gazette" or in the local newspapers.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

Thursday, June 22.

(*Before Mr. Justice* JOYCE.)

The New Inverted Incandescent Gas-Lamp Company, Limited, v. The Globe Light, Limited.

Mr. GORDON applied on behalf of the plaintiffs for a stay of execution as to costs pending an appeal from his Lordship's judgment in this patent action.*

His LORDSHIP asked whether the defendants' Solicitors were willing to give the usual undertaking to return the costs in the event of the appeal being successful.

Mr. GORDON said, so far as he knew, they would not give this undertaking, though it was usual to do so.

Mr. WALTER said he was perfectly willing to consent to a stay provided the plaintiffs would pay a sum of money into Court—he suggested £1000. The costs were exceedingly heavy, as plaintiffs had claimed practically every kind of inverted bunsen burner, and the trial had occupied some days.

Mr. GORDON said he was willing to bring £500 into Court to abide the result of the appeal.

Mr. WALTER could not accept this amount, but said he would be content with £750.

His LORDSHIP said if the parties could agree upon a figure there would be a stay upon the amount being brought in; if not, the taxation must proceed, and the amount of the taxed bill would be brought into Court.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

Tuesday, June 20.

(*Before Mr. Justice* JOYCE.)

Chiswick Urban District Council v. Metropolitan Water Board.

The short point for decision in this case was whether or not ratepayers in the district formerly supplied with water by the West Middlesex Water-Works Company were entitled to a rebate upon their water-rate.

Mr. H. H. ASQUITH, K.C., M.P., Mr. DANCKWERTS, K.C., Mr. C. E. BOVILL, and Mr. T. CUTHBERTSON (instructed by Messrs. Lyell and Betenson) appeared for the plaintiffs; Mr. FLETCHER MOULTON, K.C., Mr. HUGHES, K.C., and Mr. A. B. SHAW (instructed by Mr. A. B. Pilling) represented the defendants.

Plaintiffs claimed a declaration that the undertaking of the West Middlesex Water-Works was held by the defendant Water Board subject to the duties, liabilities, and obligations of the Company in section 3 of the Metropolis Water Act, 1902, including those imposed upon the Company by the Water-Works Clauses Act, 1847, and in particular by sections 75 to 84; a declaration that, for the purposes of the sections of the Water-Works Clauses Act, the undertaking of the Company as held by the Metropolitan Water Board was not to be treated as one with the several other undertakings by the Metropolis Water Act, 1902, transferred to, and vested in, the Water Board, but as a separate undertaking with a nominal capital equal in amount to the capital of the Company on June 24, 1904; also a declaration that the scale of water charges, including an allowance for rebate actually made and enforced by the Company prior to the date of their transfer to the Water Board, continued in force until it should be repealed, altered, or superseded by Act of Parliament. Up to June 24, 1904, plaintiffs, who were large consumers of water in connection with the discharge of their duties as the Local Authority for the district, were supplied with water by the West Middlesex Company, whose undertaking had been transferred to the Water Board by the Act of 1902. The Company were prohibited from paying interest at a higher rate than 10 per cent. on their paid-up capital; and when in any year the profits exceeded an amount sufficient to pay a 10 per cent. dividend, and had provided a reserve fund equal in amount to one-tenth of their capital and made up all deficiencies of dividend, the Company were liable, on application by petition to Quarter Sessions of any two of their consumers, to an order on them making such a rateable reduction in the rate for water supplied by them as the Court of Quarter Sessions should think proper, but so that such rate, when reduced, should ensure to the Company a profit as near as might be to 10 per cent. per annum on their paid-up capital. In each of the years 1887-90, the profits, after making up all deficiencies, &c., were more than sufficient to pay a 10 per cent. dividend; and the Company anticipated any application for a reduction by making a rebate to the consumers of 5 per cent. on the amounts charged for water. Similarly, in the years 1890-94 a rebate of 7½ per cent. was made, and in 1894-01 a rebate of 5 per cent. was made. On June 24, 1904, the "appointed day," the Company had made up all their back-dividends, and had a reserve fund equal to one-tenth of their nominal capital, which reserve fund was, on that day, transferred to the Water Board. The Board had demanded the same rate as the Company, but had not made any rebate. For the defendants, it was urged that they had passed a resolution varying the charges, which they had power to do without going to Parliament. The object of the Water-Works Clauses Act was to prevent private persons from making a large profit out of water; but when the Board was brought into existence that object had disappeared, and the Act had now no application at all. If the Board made a loss in carrying on its business, it had to be made up by the different authorities in proportion to their rateable value, while any profit had to go towards the reduction of debt.

His LORDSHIP said before delivering judgment, he would carefully consider the sections of the different Acts to which he had been referred.

Thursday, June 22.

His LORDSHIP, in giving judgment to-day, said: The West Middlesex Company was incorporated by an Act of 1806, and was regulated by various subsequent Acts, and in particular by the Act of 1852, which incorporated the Water-Works Clauses Act, 1847, with immaterial exceptions, and prescribed, by section 39, the rates at which water should be supplied for domestic purposes. The Act of 1847 contained clauses restricting the amount of profit to be received by the undertakers when the water-works were carried on for their benefit, and provided that, when the profits exceeded a certain amount, the excess was to be carried to a reserve fund, and, finally, if the profits exceeded the amount required for these purposes, any two ratepayers might apply to the Court of Quarter Sessions and obtain an order for the reduction of the water-rate. On May 10, 1887, the Company, thinking that circumstances had arisen under which such an application might be made, resolved, after careful consideration, during the pleasure of the Board and so long as the income and expenditure of the Company justified such a proceeding, to make a reduction on the water-rates. Pursuant to this resolution, the Company continued to make a rebate; the rate in the demand note being called "scale of rates and charges pursuant to 15 and 16 Vic." Then came the Act of 1902 constituting the Water Board, and vesting the West Middlesex Company's undertaking in the Board, with the "rights and subject to the obligations of that Company." The Board proceeded to collect the rates just as before, and in a precisely similar form. So things went on till December, 1904, when a resolution of the Finance Committee was passed discontinuing the rebate; and plaintiffs, objecting to the proposed alteration, brought the present action, claiming a declaration that the scale of water charges, including an allowance for rebate actually made and enforced by the Company prior to the transfer to the Water Board, continued in force until it should be repealed, altered, or superseded by Act of Parliament. If the Act of 1902 had not been passed, the Water Company could (subject to the possibility of an application being made under the Act of 1847), have determined the so-called rebate. Whether such an application as was provided for by the Act could succeed as against the Water Board he was not called upon to decide; but if he did effect to decide it, he did not see that his decision would be binding, as the ratepayers were not before the Court. However, he did not hesitate to express the opinion, after having looked into the various sections of the Act, that the clauses had ceased to operate, and were unworkable under the altered circumstances. He might observe, in passing, that the accounts and balance-sheets of the old Water Company were to be kept as before until the "appointed day." But then there was an end of it. Again, Why should not the Water Board do whatever the old Company could have done? It had been contended that the Water Board was precluded from doing it by the provisions of section 46 of the Act of 1902; but he had no doubt that all section 46 meant was that the bye-laws, regulations, and scale of water charges were to continue in force until repealed, altered, or superseded by a competent authority in a lawful manner. The section provided that the scale of water charges was to continue in force—that is to say, they were not to be increased or reduced until repealed, altered, or superseded. With reference to reduction, sub-section 6 of section 15 provided that the Board should not, until Parliament so determined, alter the water rate. If the "scale of water charges" in section 46 meant the rate described in the Special Act, then, of course, those rates could not be altered except by Parliament. If the "scale of water charges" meant the rates charged as modified by the allowance for rebate, he did not see why the Board could not increase those charges so long as they kept within the limits of the Special Act. The result was that the action would be dismissed.

The Local Government Board and Suction-Gas Producers.—With reference to the statement reported to have been made by the Local Government Board Inspector in the course of an inquiry at Uxbridge, that the Board would not sanction a loan for suction-gas plant, as they considered it to be at present in an experimental stage (*ante*, p. 909), Mr. Hugh Campbell, of the Campbell Gas-Engine Company, Limited, writes to the "Engineer" to point out that this view is not universally held by the Board. The Company twelve months ago secured an order from the Chippenham Urban District Council for a pumping installation, consisting of three gas-engines, with suction plants, for driving well pumps, the cost of which is to be paid out of a loan granted by the Local Government Board for this specific purpose. Similar plant has also been put down by the Company (among other places) at the Combe Down Water-Works, where it has proved its economy against steam, which was previously used, and at the First Garden City Water-Works. Mr. Campbell remarks that "while it is true that the suction-gas plant has not been offered freely here until about two years ago, it has been in regular use on the Continent for several years past; and it is probably more common than any other form of motive power in Germany and in France."

* See *ante*, p. 591.

MISCELLANEOUS NEWS.

NEXT YEAR'S EXAMINATION IN GAS MANUFACTURE.

With regard to next year's examination in "Gas Manufacture," the City and Guilds of London Institute state in their programme (which is noticed elsewhere in this issue of the "JOURNAL") that questions will be included on such subjects as the following:

HONOURS GRADE.

(1) The characteristic properties of the various kinds of coal, and their value for gas-making purposes. (2) The effects of temperature upon the production of residuals. (3) The chemical composition of coal gas, and the effect of each component upon the illuminating and calorific power of the gas. (4) The principles of combustion, and their application to the working of retort-furnaces. (5) The more advanced physical and chemical principles involved in the processes of destructive distillation of coal, and in the condensation and purification of the resulting gas. (6) The methods of gas analysis, including those for ascertaining the amount of the impurities in the crude gas. (7) The practice of photometry, and the determination of the calorific power of gas. (8) Best means of burning the gas in order to develop its illuminating power to the greatest advantage. (9) Labour-saving appliances in the retort-house, and the working of retorts. (10) The construction of gasholders, purifiers, and other gas apparatus. (11) The management of the various portions of the plant in order to obtain the best efficiency of the apparatus, with due regard to economy in working. (12) The method of dealing with such emergencies as are of more common occurrence in gas-works through breakdown of machinery or other failure of plant. (13) The working up of ammoniacal liquor. (14) The manufacture and purification of uncarburetted and carburetted water gas. (15) Methods of enrichment of coal gas by means of oil, &c. (16) Such important recent developments of the gas industry as have been fully described in the Technical Press.

ORDINARY GRADE.

(1) The construction of a retort or oven best adapted for the destructive distillation of coal. (2) The setting of retorts and the construction of retort furnaces. (3) The effects of temperature in modifying the quantity and quality of gas produced. (4) The description and arrangement of apparatus employed for the conveyance of the gas immediately upon its leaving the retorts. (5) Apparatus best adapted for cooling the gas and for removing the products of condensation. (6) The methods of removing the gaseous impurities from the cooled gas, including a description of the materials employed and the most suitable condition of the gas for effective purification. (7) The use of an exhauster. (8) The methods employed for controlling the pressure at the works, so as to secure an adequate supply of gas at the various points of consumption, with a due regard for economical effect. (9) The various instruments used in gas-works for ascertaining and recording pressure and exhaust. (10) The laying of mains and service-pipes. (11) The construction and fixing of gas-meters, and the fitting up of premises for the supply of gas. (12) The various forms of gas-burners in general use. (13) The simplest methods of ascertaining the illuminating power of gas. (14) The simpler physical and chemical principles involved in the various processes of gas manufacture, and in the tests for ascertaining the illuminating power and purity of the gas and the value of the bye-products. (15) The practical method of carrying out these tests. (16) Influence of temperature and pressure on volume of gas.

A TEN YEARS' COMPARATIVE STATEMENT FROM EDINBURGH.

In view of the fact that the annual accounts were to be laid before the Edinburgh and Leith Corporations' Gas Commissioners at their meeting yesterday, Mr. W. R. Herring, the Engineer, prepared for their information a comparative statement, showing the gross profit, economy in manufacturing costs, and advance in the revenue from the sale of the residual products during the last ten years. The figures represent for the first time "a clear year's operation of the new works without being seriously hampered with the operations at the older works." The price of gas during the year, it is noticed, has been lower than at any time in the decade; and the 3d. reduction that has been made represents a sum of no less than £22,917 per annum in the pockets of the consumers. Residuals have served the Commissioners well; but it is the column of "Manufacturing wages and charges, including purification," that will particularly rivet the attention of engineering readers, seeing that the last few figures in the column tell of what has been accomplished since work began at Granton. The last figure of all, however, which shows the cost of working with Granton alone, after the closing down of the New Street works, is the one which will create some astonishment, seeing that it is considerably less than half the figures for 1901 and 1902, when less gas was being made, and work was being carried on under other conditions. Rates and taxes have risen considerably; but notwithstanding this and the £22,917 presented to the consumers, the balance of gross profit stands at £91,733. Compare this with the figures of previous years, taking into consideration the advantage which the consumers and city have gained in the price of gas, in the removal of the manufacturing operations from the city, the increased payment in rates, in the economy in manufacture; and there cannot be two opinions, among technical men, as to the wisdom of the Granton scheme.

The Annual Accounts.

Telegraphing yesterday afternoon, our Edinburgh correspondent stated: "It was reported at the meeting of the Commissioners to-day that the balance on the year's working was £91,733; and that the net balance, after payment of charges and meeting the deficit of the previous year, was £18,097. The repayment of borrowed money, redemption of annuities and reserve fund, require £18,076; so that there is £21 to be carried forward. The additional quantity of gas sold amounted to 17,600,000 cubic feet; but the revenue from the sale of gas—£255,024—was less by £4385, owing to the reduction of 3d. in price. The residuals realized £54,103, which is about £1000 more, though for certain commodities the prices have been lower. The total revenue was £309,723. The accounts were remitted to the Finance Committee for audit."

MALTA AND MEDITERRANEAN GAS COMPANY, LIMITED.

The Ordinary General Meeting of the Company was held last Tuesday, at the London Offices, 60, Gracechurch Street, E.C.—Colonel JAMES LE GEYT DANIELL in the chair.

The SECRETARY (Mr. A. W. Cooper) having read the notice convening the meeting, the Directors' report and the statement of accounts were taken as read.

The CHAIRMAN said it was with very much pleasure the Directors were able to meet the shareholders, and to report that the operations of the Company showed a steady improvement—an improvement that had been going on for some time. Not only had it enabled them to surmount the difficulties with which they were met years ago by the electric light initiated by the Government, and since carried on by them, but it had enabled them to make up the loss the Company thereby sustained in the public lighting, and to share with the consumers a portion of the prosperity in the way of a reduction in the price of gas. They had, of course, had a certain number of critics among their consumers, who, having been given an inch, thought they might have an ell. But the Directors were satisfied they had given them as much as, in the interests of the shareholders, they could afford. Not only so, but it was perfectly clear that a 5 per cent. dividend was one to which everybody was entitled in a Company like their own. Further, he believed he was correct in stating that, in no place in the Mediterranean, was gas supplied at so cheap a rate as in Malta. A glance at the profit and loss account would show that this had not been done at the cost of maintenance. Indeed, that item figured in the accounts at rather a larger amount than usual. This partly arose from the fact that they had been exchanging small mains by larger ones, and had been continuing extensions into several districts wherever they could profitably do so. Their General Manager (Mr. J. W. Starkey) and his indefatigable assistants were constantly making recommendations of extensions wherever they could see their way to getting paying consumers. Although the Directors looked into these questions very closely for themselves, their officers had in these matters the entire support of the Board, because the Directors felt and knew their officers were so good at their respective duties, and that everything both at the works and in the various districts were in the most excellent and efficient order. Malta was, of course, their principal station; and the shareholders would like to hear that, at Malta, the general consumption showed an increase during the past year of 7·88 per cent. The Military and Naval Departments had also shown

Comparative Statement showing Gross Profit, Economy in Manufacturing Costs, and Advance in Revenue from the Sale of Residual Products for the last Ten Years.

Year.	Price of Gas per 1000 Cubic Feet.	Average Cost of Coal per Ton.	Received for Residuals.	Manufacturing Wages and Charges, including Purification.	Rates and Taxes.	Balance, being Gross Profit.	Remarks.
1896	3s. 2d. and 3s.	11s. 7·8d.	£20,632 12 4	£46,662 19 8	£10,053 5 10	£38,803 16 8	
1897	3s.	11s. 2·5d.	20,854 2 7	48,286 15 2	6,360 12 8	40,570 15 2	
1898	3s.	10s. 9d.	18,985 18 2	47,864 4 9	6,568 19 6	54,924 17 2	
1899	3s.	10s. 11·6d.	24,154 14 6	50,636 10 10	8,848 11 11	58,245 4 7	
1900	3s. 4d.	12s. 9·5d.	39,928 16 11	56,083 8 8	9,622 2 7	69,458 0 1	Enhanced receipts owing to period of coal boom.
1901	3s. 4d.	16s. 11·5d.	41,761 19 4	60,283 1 11	12,096 15 5	42,156 11 2	Residual products works started.
1902	3s. 4d.	14s. 2·2d.	35,720 12 8	60,636 17 10	7,352 7 4	70,686 10 7	Granton Gas-Works started.
1903	3s.	13s. 1·9d.	51,239 6 6	54,554 5 8	12,129 11 1	82,486 11 6	
1904	3s. and 2s. 9d.	13s. 0·9d.	55,963 2 8	39,794 12 2	13,645 3 0	79,470 13 3	New Street works finally shut down.
1905	2s. 9d.	12s. 4·5d.	54,103 15 8	26,210 4 3	13,483 19 5	91,733 0 8	

NOTE.—The 3d. reduction in the price of gas represents a reduction of revenue equal to £22,917, and consequently an advantage to the consumers of this amount per annum.

an increase of 2·41 per cent. The street lights and some of the establishments, however, had shown a decrease last year of something like 2·60 per cent., which was more than counterbalanced by the increase of the military and naval stations. Comparing the sale of gas at Malta for the year 1904-5 with that of three years ago (1901-2), it showed that the increase had amounted to no less than 33·7 per cent. This steady increase would receive a check; but the increase would help them in meeting the deficiency in consumption that he feared they must experience when the naval and dockyard works were all in working order. The Admiralty proposed to light these with their own electric light, the current for which was to be generated by steam power. At the present time, they were consuming, and he hoped would continue to consume, a certain proportion of gas; in fact, the Board had reason to think they were quite prepared to do so. Regarding Trapani, the shareholders would see a remark in the reportto the effect that the Municipality had made up their minds to avail themselves of the powers given them by their Parliament to buy the Company's works in the town. The unexpired term of the Company's concession there was ten years from next August. The Company were very much indebted to their friend, Mr. A. F. Phillips, for the assistance he had given them in this matter. He had introduced the Board to a most able Italian Engineer and also to a Solicitor who was on the spot, and who understood thoroughly the Italian laws. This was really all he could say about this particular matter at present, because the position that day did not enable him to say very much. Of this the shareholders might be quite sure, that the views of the Municipality and those of the Board, when the valuations were made, would differ very materially, and some time would be required to reconcile them. In regard to Marsala, there was very little indeed to report. There was a slight reduction there in the sale of gas last year; and this had arisen from the fact that the Directors had agreed to extinguish some of the public lights at midnight, instead of keeping them alight all through the night. Taking the accounts generally, coal, oil, and coke had cost £404 more. The cost of coal averaged 16s. 7d. per ton. The cost of gas making was only £253 more; and for this Malta was mainly responsible. In maintenance, there was an increase of £425; but this he had already referred to when making his remarks concerning Malta. Rents, rates, and taxes showed an increase of £164. They were not paying more for rent; and as to the rates and taxes, he must refer the shareholders to the Chancellor of the Exchequer—the matter being entirely outside the power of the Board. (Laughter.) General trade charges showed an increase of £323; and this might require a little explanation. It was accounted for by the expense of inspecting the stations. Mr. Phillips had been out there, and inspected all the stations, and had paid visits to Trapani on the business to which he (the Chairman) had already alluded. On the credit side of the account, the shareholders would observe the gas sold had realized £784 more; the increase being at the rate of 4·88 per cent.—that was, taking all the stations together. The item of fittings and meters showed an increase of 8 42 per cent. The result of the whole working was a balance of £9892, which was carried to the general revenue account. Turning to that account, it would be noticed that the interest on debentures was somewhat less, because they had paid off £1200 of debentures last year; and this was not a bad investment for the Company. Then £2000 had been carried to the amortization account, which in the general balance-sheet stood at £15,805. On the other side of the general balance-sheet, the stocks at the stations figured at £11,921—being an increase of £2878; but none of the stocks had been overvalued. The investments stood at a book value of £10.905. The certificates of their brokers quite justified them in keeping them at this price in the books; the present selling price amounting to more than the £10,905. These were all the remarks he had to make; and he moved the adoption of the report and accounts.

Mr. STEPHENSON R. CLARKE seconded the motion, which was at once unanimously carried.

Proposed by the CHAIRMAN, and seconded by Mr. A. F. PHILLIPS, a dividend was declared at the rate of 7 per cent. per annum on the first preference shares, of 7½ per cent. on the second preference shares, and of 5 per cent. on the ordinary shares—deducting the payments already made on account.

On the motion of the CHAIRMAN, seconded by Mr. A. M. PADDON, the retiring Director (Mr. Stephenson R. Clarke) was re-elected.

Mr. JOSEPH CASH proposed, and Mr. F. R. SMITH seconded, the re-appointment of the Auditors (Messrs. R. Hesketh Jones and T. Guyatt); and this was likewise unanimously agreed to.

The CHAIRMAN moved a vote of thanks to the officers—Mr. Cooper, the Secretary, Mr. Starkey, the General Manager, Mr. R. Wilson, the Engineer at the works, Mr. W. A. Reid, the District Superintendent at Malta, Mr. F. Marino, at Trapani, and Mr. George Torrini, at Marsala. They were, he said, all active, zealous officers; and he could not say too much in their favour. This vote would be regarded by them as a great compliment; and they would also appreciate the fact that the shareholders held the same views of their officials and their work as did the Directors.

Mr. GUYATT, in seconding, said that, having gone into the accounts, and knowing what these gentlemen did, he felt satisfied the Company had an able and good staft of officers, both at home and abroad.

The motion was very cordially passed.

Mr. COOPER having responded,

Mr. JOSEPH CASH moved a hearty vote of thanks to the Chairman and Directors. He remarked that the accounts the shareholders had had put before them that day were the very best proof of the Directors' very efficient work, carried on, as the shareholders were aware, during a time of somewhat serious anxiety to them. He was sure the shareholders were perfectly safe in their hands in regard to the Trapani business, especially with the able assistance Mr. Phillips was able to bring to bear upon it.

Mr. U. T. WILKINS seconded the motion, which was agreed to.

The CHAIRMAN, in the course of his acknowledgment, said he wished Malta was a larger place, and more capable of development than it was. But the shareholders might rely upon them developing their business there wherever it was possible. With regard to Trapani, by this time next year, they would have a more settled account of affairs to talk about to the shareholders.

DUNDEE GAS UNDERTAKING.

Cookers to be Supplied Free.

On Wednesday last, the Town Council of Dundee sat as the Gas Commissioners, to consider the annual accounts of the department, which have already been referred to in the "JOURNAL."

In moving their adoption, Treasurer Ritchie said that the estimated revenue for the year with which they were dealing, including a balance from the previous year, was £106,300; while the actual revenue was £108,310, showing a surplus of £2010. The increase was largely due to the extra sale of coke, which yielded £2090 over the estimate, and the higher price received for sulphate of ammonia, which was £1040 over the estimate. The estimated expenditure, including the surplus for the year, was £106,300; and the actual expenditure had been £107,106—being an increase of £806 over the estimate. The quantity of gas delivered was 683¾ million cubic feet, or about 22 millions under the estimate. The quantity sold was 11½ millions under the estimate; but the unaccounted-for gas had been reduced by fully 9 millions. The consumption at the works had also been decreased by about 1½ millions. Taking the estimate for next year, the revenue from all sources was calculated at £102,928, and the expenditure at £101,668, showing a surplus of £1259. It was now proposed that the price of gas be reduced by 2d. per 1000 cubic feet; provision having been made for this in the estimate. The sinking fund charged against revenue this year amounted to nearly £10,550, or fully 2½ per cent. on the present amount of debt. The market for residual products was still in a very depressed state. Taking the average price of tar for the last two years, it showed a decrease of £1313. Sulphate of ammonia had been fairly steady; and the average price for the past year showed a slight increase. He proposed that the price of gas be charged as follows: To consumers in Dundee, 2s. 8d. per 1000 cubic feet; in Invergowrie, 3s. 8d.; in Downfield, 3s. 8d.; beyond the eastern boundary, 3s. 8d.; Harbour lamps, 2s. 8d.; Invergowrie lamps, 3s. 8d.; and Downfield lamps, 3s. 8d. Also that the price for motive power should be at the rate of 2s. 5d. in Dundee, and 3s. 5d. in Invergowrie, Downfield, and beyond the eastern boundary, respectively, if taken through a separate meter. All prices to be subject to a discount of 5 per cent. if paid within a month after accounts are rendered.

The accounts and estimates having been approved, the Treasurer proposed that gas-cookers be issued free; and after this had been formally seconded, Mr. Brownlee moved, as an amendment, that no change be made. He would have expected, he said, that a matter so important as this would have been brought before the Gas Committee and very carefully considered; but no such thing had been done, nor, indeed, had any explanation been offered other than a statement issued by the Manager (Mr. A. Yuill). He did not at all agree with Mr. Yuill's conclusions. In the first place, he prceeeded on the assumption that this was a day supply; but nothing could be more delusive. Then, with regard to English comparisons, the system of housing in England and Scotland was different. An English house had not fewer than four or five rooms—some of them more—and might be inhabited by more than two families; but still there was only one cooker. In Dundee, a large proportion of the population was housed in single rooms. Were they to put a cooker in every one of these houses? The users of cookers, he held, were no more entitled to a reduction than lighting consumers. They would find that, under the conditions Mr. Yuill proposed to apply, they would not be getting more than 1s. per 1000 cubic feet for the gas. Why was a man who burned gas for cooking purposes to have it practically 1s. per 1000 cubic feet cheaper than a man who used it for lighting? This was grossly unfair to the lighting consumer. The cost of gas was not as the Manager gave it—tbe cost of manufacture—but the figure at which it was sold by the Commissioners. If they increased their supplies, they must increase their staff and everything else in proportion. Mr. Mechan seconded the amendment, remarking that it was not a matter of giving free cookers, because it was provided that people must use 12,000 cubic feet up to 20,000 cubic feet of gas per annum, and they had to pay for it whether they used it or not. This would be very much more than they would pay for the rent of a cooker. It would be a much more honest plan to charge a small rent to cover interest and other items. Mr. Nairn supported the motion. He said they had 1s. 5d. of standing charges to meet. If they used more gas than they were doing, it did not increase that a penny. On the contrary, the more they used, and the more they made, it reduced the standing charges. To give free cookers would be one of the best things they could do for the working people of Dundee. Mr. Speed held that the proposal should not be entertained. It was not on a par with free meters. A meter was used by everyone who consumed gas; but cookers were only employed by a minority, and it was unfair to those who did not use them to give a benefit to those who did. He quoted figures to show that, assuming the increase in cookers in Dundee was equivalent to that which had taken place in the issue at Manchester, it would cost the Gas Commission £7700 per annum to meet the cost of fitting, upkeep, maintenance, interest on capital value, and sinking fund. If they had anything to spare it would be better spent in lighting up the bye-streets and alleys of the city, and in giving a concession to those people, generally of the humble class, who used the penny-in-the-slot meters. Mr. Soutar moved, as an amendment, that the meeting of the Commission be adjourned pending the report of the Gas Committee; and Mr. Brownlee withdrew his amendment in favour of this. Mr. High, supporting the Treasurer's proposal, said that in the 2½ years Mr. Yuill had been with them he had reduced the capital charges by £30,000, had rebuilt the retort-house out of revenue at a cost of £10,000, and had reduced the price of gas from 3s. 6d. to 2s. 8d. per 1000 cubic feet. Previous to Mr. Yuill's advent, the loss of the department was £7000 to £8000 per annum. On a division, the Treasurer's motion was carried by 14 votes to 5. Mr. Stevenson afterwards moved a vote of thanks to Mr. Yuill and the other officials. He said that his experience of the Gas Manager was that he was giving close attention to his work, that he was a very conscientious and able man, and that he was one who could be trusted. Bailie Doig seconded, and moved a similar vote to Treasurer Ritchie.

THE FATAL EXPLOSION AT THE SALTLEY GAS-WORKS.

Factory Inspectors' Reports.

The Blue-Book dealing with the operations of the Inspectors under the Factory Acts during 1904, which was issued last week, contains a reference to the fatal accident which occurred at the Saltley Gas-Works of the Birmingham Corporation in October. In the course of his report to the Chief Inspector of Factories, Mr. J. A. Redgrave, the Superintending Inspector for the Midland Division, gives the following statements.

Mr. Knyvett (Birmingham), who analyzes some of the accidents in his district, and presents a report from his junior colleague, Mr. Duckering, on the serious gas explosion at Saltley, says: The only fatal accident from which a lesson may be learnt was the very serious one at the Saltley Gas-Works, belonging to the Corporation of Birmingham, which caused the death of three workers. The circumstances are fully described in Mr. Duckering's report; but I think I should mention my very definite view that the explosion would not have occurred at all had such a safety lamp been in use as would be required by the Mines Regulation Act in places subject to gas explosion, and, further, that, in the event of the explosion, the deaths would in all probability not have occurred had the building been properly constructed for its purposes. Owing to the absence of a reasonable amount of outlet, the escaped gas became collected in a corner of the shop, and really thus courted the explosion which very shortly followed. Even then the men did not meet their deaths from the effects of the explosion, but were buried beneath a concrete floor belonging to a second storey in the shop, which fell upon them.

Mr. Duckering's report is as follows: The explosion occurred in a gas-works where only coal gas is manufactured. The gas is exhausted by means of engines from the retorts through coolers, washers and scrubbers. It is then forced through purifiers. These purifiers consist of boxes of oxide of iron and boxes of lime; and the gas is made to pass first through a succession of oxide of iron boxes and then lime boxes. The oxide of iron and lime are arranged on gratings; and the gas must pass through the solids. Hence a danger of a block occurs. The boxes are, therefore, arranged with water-seals—*i.e.*, the lids, instead of fitting closely, dip merely into troughs of water. If a block occurs, the pressure, of course, rises till it overcomes the pressure of the water in the lutes. It then escapes into the atmosphere. Gauges are provided at different parts of the works; and it is the duty of certain men to watch these gauges, and, if a rise in pressure is noted, at once to inform a valveman—*i.e.*, a man in charge of the purifying plant. This was done; and it was then the duty of the valveman to relieve the pressure by altering the course of the gas through the purifying-boxes. He, however, went to perform some other duty first; and, meanwhile, the pressure rose so high as to force the water-lutes. The course of the gas through the purifying-boxes is controlled by valves known as centre-valves. These are huge arrangements moved by a winch; and the whole of the communications with one set of boxes can be controlled by this one valve. Its great disadvantage, however, is that it takes several men to work it. The valveman, therefore, collected all the men he could find, and proceeded to alter this valve. He was provided with a safety lamp; and on entering the purifying-house, into which gas had all the time been pouring, no evil result happened. He, however, appears to have lost his head to some extent; and he could not get the valve into the proper position for diverting the stream of gas, and so stopping the escape. He therefore proceeded down the centre gangway of the purifying-house for some unknown purpose; the other men following him. The explosion then occurred, and he and two of his companions were killed, while three others were injured, two of them very severely.

The building in use was of very massive construction, the walls being of brick and of great thickness. In each of the walls there were many openings; but the area of these openings was not very large as compared with the total area of the walls. Above the floor containing the boxes (the ground floor) was a second floor of very thick concrete carried on iron girders, and above this again was the roof. The construction of the building did not allow of a free circulation of air, but offered considerable opportunity for the gas to collect within the building. The conclusion drawn was that a purifying-house should be of such construction as to allow of very free circulation of air. It should, in fact, be merely a roof supported by iron pillars, leaving the sides and ends perfectly open, so that there would be no possibility of gas collecting in the house. Further, the most severe injuries resulted, not from burns, but from falling *débris*. The explosion blew out the end wall of the building, and brought down the whole of the concrete floor above. The three men killed were found below this concrete—*i.e.*, buried in it—while those who survived were apparently blown through the openings in the walls, and so escaped the effects of the falling concrete. The conclusion here is also that no floor should be placed above the purifying-floor, though provided open sides are used it has not so much force, since the gas would, most probably, not collect under those conditions, and if it did collect to some extent any explosion resulting would not be so severe in its effects as in the confined space of the purifying-house. The necessity for so many men to be present was due to the fact that they were required to work the centre-valve; and if this were absolutely necessary, the conclusion to be drawn is that some simpler type of valve, involving the presence of a less number of men at such a dangerous period, should be used. However, by one of the rules of the works, the valveman's first duty was to turn a bye-pass valve and allow the gas to miss the series of boxes affected. This can be done by one man with a simple turnkey. It was not, however, done in this case; and it is not possible to fix responsibility for this breach, since the man in charge was killed. Provided this rule as to the use in the first instance of the bye-pass valve is observed, no fault can be found with the use of centre-valves.

The safety lamp used is a very good one for ordinary use in a gas-works—*i.e.*, for all places where there is no danger of escape of gas in large volume; but in such a case as occurred here the lamp is fearfully dangerous, especially in the hands of an ordinary workman. The mining expert called by the Coroner at the adjourned inquest said that the lamp had far too much glass about it, had much too large a flame, was too large in itself, had far too great a surface area in proportion to the area of gauze used, and, finally, that the size of the flame was far too great when compared with the area of the surrounding gauze. Further, he said that in an explosive mixture the lamp would rapidly grow hot, and would eventually explode the gas; and this would be hastened if the lamp were swung about. The method of testing adopted was to allow a stream of gas to play over the outside of the lamp. If the flame inside the lamp ignited the stream of gas, the lamp was deemed defective. If it did not so ignite the gas, the lamp was deemed so far at least sound. It may be pointed out that in the hands of a careful and scientific man this test will only show a defect in a certain percentage of cases. After passing the above test, the lamp was placed lighted under a cylinder, and a stream of gas was allowed to enter the cylinder through a slot at the bottom. If no explosion followed, and if the lamp went out, it was deemed to be safe. Here again the test is extremely uncertain, and in any case does not reproduce the conditions of danger found in actual practice. As a matter of fact, a lamp was actually made defective and submitted to the test; but judging by the results, the lamp was perfectly sound. Only when a defect was produced which was perfectly palpable without any test would the tests show the lamp defective. Not only was this so, but the tests, which took place daily, were carried out by an ordinary labourer, who certainly could not understand the difficulties and errors inherent in every test. No evidence which would show how the gas was ignited could be obtained. The evidence of the mining expert, before referred to, showed that a good lamp, normally used, might have caused ignition; but it is equally certain that a defective lamp might have been used in spite of the fact that the lamp that was actually used had been recently tested.

SMETHWICK GAS DEPARTMENT.

Annual Report.

The annual report of the Smethwick gas undertaking for the year to March 31 has just been issued by the Secretary (Mr. W. J. Sturges). It states that it has not been necessary to raise any additional capital; and the total loan indebtedness, after deducting loans repaid, amounting to £1408, has been decreased to £201,017. The expenditure on capital account during the year has been £2859, bringing the total capital outlay up to £211,442, or an average of 12s. 1·6d. per 1000 cubic feet of gas sold, as against 12s. 5·9d. for the previons year. The total sales of gas show the satisfactory increase of 4·33 per cent. over the previous year. Prepayment consumers exhibit an increase of 23⅜ per cent.; but the large consumers took 9¼ per cent. less. The consumption for motive power and manufacturing purposes increased by 19½ per cent. The total quantity of gas sold during the year was 348½ million cubic feet, against 334 million feet—an increase of 14½ million feet. The unaccounted-for gas amounted to 5·33 per cent., which was a slight improvement upon the previous year, when the percentage was 5·87. The number of ordinary meters in use at the end of the year was 3353, or an increase of 78; and the number of prepayment meters was 4739, or an increase of 663. There were also on hire and in use at March 31 of this year 831 cooking-stoves, against 743 for the previous year. The income from the sale of gas, after providing for increased discounts (a rebate of 5 per cent., amounting to £304, having been allowed to the prepayment consumers), shows an increase of £1274; but the returns from residuals were slightly less. The amount of coke and breeze used for heating the retorts, boilers, &c., was 4453 tons, representing 23·71 per cent. of the quantity made, as compared with 24·52 per cent. for the previous year. The total income was £54,527, as against £53,413; the expenditure was £38,628, as against £37,630. The average price of coal used, including haulage, stacking, &c., was 13s. 4·05d. per ton, against 13s. 10·07d. in the previous year; and the quantity of coal carbonized was 31,284 tons, from which was produced 356½ million cubic feet of gas, or an average of 11,397 cubic feet per ton, or 90 feet better than in the preceding year—a result upon which the Engineer (Mr. Vincent Hughes) is to be congratulated. The quantity of coke used for manufacturing water gas was 203 tons, producing nearly 11½ million cubic feet of this gas, or 56,251 feet per ton, against 56,444 feet in the previous year. The total quantity of gas made was 368 million cubic feet, or an increase of 3·68 per cent. over the preceding year. The number of public lamps is now 1097, of which 925 are incandescent, and the remaining 172 are being converted. Rates and taxes absorbed over 1½d. per 1000 cubic feet of gas sold. The gross profit amounted to £15,899, or equivalent to 10·951d. per 1000 cubic feet of gas sold, as compared with £15,783, or 11·342d. per 1000 cubic feet sold, the previous year. The charges in respect of interest and instalment of loan and sinking fund for the redemption of debt amounted in the aggregate to £10,215; and after meeting these liabilities, the surplus remaining as net profit for the year is £5684, or a decrease of £237. Having made provision for a contribution of £2000 to the general district rate, there is a balance of £3684 to carry to the credit of the depreciation and suspense fund account. The total expenditure defrayed out of this fund during the last four years amounts to £12,057—for water-gas plant £9556, and for mains £2501.

The Street Lighting Difficulty at Romsey.—The dispute between the Romsey Town Council and the ratepayers as to the lighting of the street lamps during the summer months, which was referred to in the "JOURNAL" last week (p. 900), has, it is gratifying to learn, now been settled. The fairy lights and Chinese lanterns have been supplanted by "Mall" incandescent street-lamps, manufactured by Mr. William Edgar, of Hammersmith, and so every one in the place should be reasonably satisfied.

SOUTHPORT GAS-WORKS RESULTS.

At the Monthly Meeting of the Southport Town Council, Alderman G. F. Travis, the Chairman of the Gas Committee, in moving the adoption of the proceedings of the Committee—including the annual report of the Engineer (Mr. John Bond) which was noticed last week, p. 901—said it was pleasing to find that the profit for the year was £1500 more than the £10,000 of the preceding year. After taking into account the reduced price which they had to pay for coals, and deducting from that a somewhat less price for residuals, they benefited to the extent of £900 by their carbonizing materials. The additional profit mentioned had been transferred to the Finance Committee, and had gone in aid of the rates; and they were so well pleased with the position of the undertaking that they looked for something better in the future. So much was this the case, that they had promised the Finance Committee £13,000 for the coming year. The profit of the year under review had been made after allowing a good deal for bad debts, and also after making ample provision for many alterations which they were carrying out, so that they would be a charge against revenue, and not capital except as regarded what was absolutely new work. During the present year the rental of cookers would be lower than in the past; and those who had had their cookers longest would get them at a lower rate than those who had recently taken them. Their desire was to continue the policy of increasing the consumption of gas, not only for lighting and cooking but for other purposes, so that the profits might be larger in the future. He complimented Mr. Bond on the excellent manner in which he had handled the estate during the year. The minutes were adopted.

A GOOD YEAR AT OSSETT.

The annual report of Mr. A. E. Mottram, the Gas Manager to the Ossett Town Council, states that last year there was an increased consumption of 7 per cent.; the quantity of gas sold being about 88¾ million cubic feet, which was nearly 6 million feet more than in the preceding twelve months. The make per ton was 10,873 cubic feet, as compared with 11,014 feet. Along with other gas undertakings, Ossett experienced a considerable falling off in the receipts from residuals; but the effect of this was minimized by the fact that the coal contracts were also at reduced prices. During the year the consumers were given the benefit of reductions in the price of gas amounting to over £1000; but in spite of this there was a gross profit of £7588. Interest and sinking fund charges amounted to £6586, leaving a net profit of £1002, which has been allocated to the reduction of the alteration of retort-house suspense account. The large reduction in the price of gas used for motive power and cooking purposes, together with the facilities granted for obtaining gas engines and cookers, has led to a largely increased consumption—amounting to 11 per cent. for motive power, and 34 per cent. for cooking. The gross cost of production and distribution was 1s. 11·54d., as compared with 2s. 0·69d. per 1000 cubic feet; and the receipts from sales of gas, meter-rents, &c., were 2s. 11·42d., as against 3s. 1·10d. per 1000 cubic feet—the difference being accounted for by the reduction in the price of gas.

In moving the adoption by the Town Council of the Gas Committee's minutes containing the report and balance-sheet, the Mayor (Alderman Audsley) said that the 2842 slot consumers had used 17½ million cubic feet, or an average of 6600 feet each, at a cost of £1 3s. 7d. per annum, or ¾d. per day. Taking the whole of the customers, the average consumption had been 15,000 feet, costing £2 4s., or 1½d. per day. As nearly one-half of the gas was used by large consumers, they might take it that the average bill of cottage and small houses was ¾d. per day. Notwithstanding the popularity of slot meters, the consumption through ordinary meters had increased by 3 per cent. After referring at some length to the advantages of gas for cooking and motive power purposes, he remarked that at the present rate the suspense account would be completely wiped out in two years' time; and if the good management was continued the gas could then be reduced in price until it became the cheapest in the neighbourhood. He quoted some figures showing the improvements in working that had taken place since the Council took over the works, and concluded by saying that the undertaking was proving to be what it was stated it would be—a gold mine for the ratepayers.

The minutes were adopted.

SALE OF STOCKS AND SHARES.

At the Auction Mart, Tokenhouse Yard, E.C., last Tuesday, Mr. Alfred Richards disposed of new issues of debenture and ordinary capital by order of the Directors of the Great Yarmouth Water-Works Company, the Grays Gas Company, Limited, and the Southend Water-Works Company. In the case of the Great Yarmouth Water Company, 200 £10 ordinary shares were offered, ranking for a maximum dividend of 7 per cent. per annum; the dividend on similar shares having been for the past nine years at the rate of 4 per cent. These were sold at from £10 to £10 2s. 6d. per share; while £3000 of 4 per cent. perpetual debenture stock in the same Company realized from £103 to £104 per £100 of stock. There were next offered 600 £10 fully-paid "B" shares in the Grays Gas Company, Limited, ranking for a maximum dividend of 7 per cent.; the last dividend on the Company's "B" capital having been at the rate of £5 12s. per cent. per annum. The whole of this issue was disposed of at £10 5s per share. In the Southend Water Company, 2105 £10 new ordinary shares were sold. These shares rank for a maximum dividend of 5 per cent. per annum; and in view of the dividends paid on the Company's existing capital, they are entitled to receive this amount. They were disposed of at £10 to £10 2s. 6d. per share.

The Architect of the West Ham Education Committee has arranged with Mr. John Clark, the Engineer of the West Ham Gas Company, to conduct a series of experiments in gas lighting in the Upton Lane School, with a view to a comparison of the consumption of gas under various systems.

GAS COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 941.

Issue.	Share.	When Div.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
500,000	10	Apl. 13	10½	Alliance & Dublin 10 p.c.	21—22	..	4 15 5
160,000	10	,,	7½	Do. 7 p.c.	14—15	..	5 0 0
200,000	5	May 12	6½	Bombay, Ltd.. . . .	6⅛—7	..	4 12 10
140,000	5	,,	6½	Do. New, £4 paid	5—5⅛	..	4 14 6
50,000	10	Mch. 15	14	Bourne- } 10 p.c. . .	29½—30½	..	4 11 10
251,810	10	,,	7	mouth Gas } B 7 p.c. .	16½—17½	..	4 0 0
53,200	10	,,	6	and Water } Pref. 6 p.c.	15¼—16½	..	3 12 9
380,000	Stk.	Feb. 24	12	Brentford Consolidated	247—252	..	4 15 3
300,000	,,	,,	9	Do. New . . .	185—190	..	4 14 9
50,000	,,	,,	5	Do. 5 p.c. Pref. .	127—132	..	3 15 9
206,250	,,	June 15	4	Do. 4 p.c. Deb. .	103—106*	..	3 15 6
220,000	Stk.	Mch. 15	11	Brighton & Hove Orig.	225—230	..	4 15 8
246,320	,,	,,	8	Do. A. Ord. Stk. .	165—170	..	4 14 2
460,000	20	Mch. 30	10	British	40—41	..	4 17 7
100,000	Stk.	Feb. 24	6	Bromley, Ord. 5 p.c. .	120—125	..	4 16 0
165,700	,,	,,	4½	Do. do. 3½ p.c. .	90—94	..	4 15 9
500,000	10	May 12	7	Buenos Ayres (New) Ltd.	11⅞—12¼	..	5 14 3
250,000	Stk.	Dec. 30	4	Do. 4 p.c. Deb. .	97—99	..	4 0 10
150,000	20	Mch. 15	8½	Cagliari, Ltd.	25—27	..	6 2 3
100,000	10	May 31	10	Cape Town & Dis., Ltd.	17—17½	..	5 14 3
100,000	10	Apl. 28	4½	Do. 4½ p.c Pref. . .	9¾—10¼	..	4 7 10
50,000	50	May 2	6	Do. 6 p.c. 1st Mort.	52—54	..	5 11 1
800,000	Stk.	Dec. 30	4⅜	Do. 4⅜ p.c. Deb. Stk.	101—103	..	4 7 5
1,400,000	Stk.	Feb. 24	5⅛	Commercial 4 p.c Stk. .	115—118	+1	4 8 1
560,000	,,	,,	5	Do. 3½ p.c. do. .	111—114	..	4 7 9
450,000	,,	June 15	3	Do. 3 p.c. Deb. Stk.	85—87*	..	3 9 0
800,000	Stk.	,,	6	Continental Union, Ltd.	108—111*	..	5 8 1
200,000	,,	,,	7	Do. 7 p c Pref.	137—142*	..	4 18 7
424,070	Stk.	Feb. 18	5½	Derby Con. Stk. . . .	124—126	..	4 7 4
55,000	,,	June 3	4	Do. Deb. Stk. . . .	108—110	..	3 12 9
486,090	10	Jan. 27	11	European, Ltd. . . .	22—23	..	4 15 8
354,060	10	,,	11	Do. £7 10s. paid	15—16	..	5 3 2
15,243,200	Stk.	Feb. 10	4⅛	Gas- } 4 p.c. Ord. . .	99—100	..	4 8 0
2,600,000	,,	,,	3½	light } 3½ p.c. max. . .	92—94	..	3 14 6
3,799,735	,,	,,	4	and } 4 p.c. Con. Pref.	109—111	..	3 12 1
4,193,975	,,	June 15	3	Coke } 3 p.c. Con. Deb.	89—91*	..	3 5 11
258,740	Stk.	Mch. 15	5	Hastings & St. L. 3½ p.c.	100—103	..	4 17 1
70,000	10	Apl. 28	11	Hongkong & China, Ltd.	17½—18½	+⅛	5 18 11
3,800,000	Stk.	May 12	10	Imperial Continental .	211—214	..	4 13 6
473,600	Stk.	Feb. 10	3½	Do. 3½ p.c. Deb. Red.	96—98	..	3 11 5
175,242	Stk.	Mch. 15	6	Lea Bridge Ord. 5 p.c. .	120—125	..	4 16 0
561,000	Stk.	Feb. 24	10	Liverpool United A . .	224—226	+1	4 8 6
718,100	,,	,,	7	Do. do. B .	166—168	+1	4 3 4

Issue.	Share.	When Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
306,083	Stk.	Dec. 30	4	L'rpool Unit'd Deb. Stk.	111—113	..	3 10 10
75,000	5	Dec. 15	5	Malta & Medn., Ltd. .	4⅛—4⅜	..	5 5 3
560,000	100	Apl. 1	5	Met. of } 5 p.c. Deb..	101—103	..	4 17 1
250,000	100	,,	4⅓	Melbourne } 4⅓ p.c. Deb.	101—103	..	4 17 1
541,920	20	May 31	3½	Monte Video, Ltd. . .	11—12	..	5 16 8
1,565,892	Stk.	Feb. 24	4⅜	Newc'tle & G'tesh'd Con.	108⅛—109½	..	4 4 6
406,625	Stk.	Dec. 30	3½	Do. 3½ p.c. Deb.	93—95	..	3 13 8
15,000	10	Feb. 24	10	North Middlesex 10 p.c.	19—20	..	5 0 0
52,940	1	,,	7	Do. 7 p.c.	13—14	..	5 0 0
300,000	Stk.	May 12	8	Oriental, Ltd. . . .	145—148	..	5 8 1
600,000	5	Mch. 30	7	Ottoman, Ltd. . . .	6—6⅛	..	5 12 0
168,255	Stk.	—	6⅝	Plym'th & St'house 5 p.c.	—	..	—
398,490	5	Apl. 28	6	Primitiva Ord. . . .	5⅞—6	..	5 0 0
796,980	5	Jan. 27	5	Do. 5 p.c. Pref. .	5—5⅛	−⅛	4 15 3
488,900	100	June 1	4	Do. 4 p.c. Deb. .	95—97	..	4 2 6
851,070	10	Apl. 28	7	River Plate Ord. . . .	11⅞—12⅛	..	5 14 3
300,000	Stk.	Dec. 30	4	Do. 4 p.c. Deb. .	97—99	..	4 0 10
250,000	10	Apl. 13	7	San Paulo, Ltd. . . .	12⅞—13¼	..	5 5 8
70,000	50	Jan. 3	5	Do. 5 p.c. Deb. .	52—54	..	4 12 7
135,000	Stk.	Mar. 15	10	Sheffield A	235—237	..	4 4 5
209,984	,,	,,	10	Do. B	235—237	..	4 4 5
523,498	,,	,,	10	Do. C	235—237	..	4 4 5
123,998	Stk.	Mch. 30	5	Shrewsbury Ord. 5 p.c.	107—110	..	4 10 11
70,000	10	May 31	10	South African	15⅛—16⅛	..	6 1 3
6,250,000	Stk.	Feb. 10	5⅓	South Met., 4 p.c. Ord.	128—130	..	4 4 7
1,832,700	,,	Jan. 13	3	Do. 3 p.c. Deb.	90—92	..	3 5 3
575,0 0	Stk.	Feb. 24	5⅓	S'th Suburb'n Ord. 5 p.c.	121—124	..	4 8 9
60,000	,,	,,	5	Do. 5 p.c. Pref. . .	123—128	..	3 18 2
112,533	,,	Jan. 13	5	Do. 5 p.c. Deb. Stk.	130—135	..	3 14 1
502,310	Stk.	May 12	5	Southampton Ord. . .	107—110	..	4 10 11
87,950	,,	—	4	Do. 4 p.c. Deb.	—	..	—
120,000	Stk.	Feb. 24	6⅔	Tottenham } A 5 p.c. .	125—128	..	4 17 8
338,720	,,	,,	4⅔	and } B 3½ p.c. .	98—101	..	4 14 1
125,000	,,	Dec. 15	4	Edmonton } 4 p.c. Deb.	107—110	..	3 12 9
182,380	10	June 15	8	Tuscan, Ltd.	9½—10*	..	8 0 0
149,900	10	Jan. 3	5	Do. 5 p.c. Deb. Red.	104—104	..	4 16 2
30,000	Stk.	Feb. 24	7⅔	Wands- } A 5 p.c. . .	163—168	..	4 12 3
255,636	,,	,,	6⅔	worth } B 3½ p.c. . .	135—140	..	4 9 3
60,000	,,	,,	5⅔	and } C 3½ p.c. . .	114—116	..	4 13 6
57,564	,,	Dec. 30	3	Putney } 3 p.c. Deb. Stk.	82—87	..	3 9 0
745,872	,,	Mch. 15	5	West Ham 5 p.c. Ord.	102—104	..	4 16 2
185,000	,,	,,	5	Do. 5 p.c. Pref. .	123—126	..	3 19 4
193,300	,,	Dec. 30	4	Do. 4 p.c. Deb. Stk.	105—110	..	3 12 9

Prices marked * are "Ex div."

CHELSEA WATER-WORKS COMPANY.

A General Meeting of this Company was held last Thursday at the Offices, Commercial Road, Pimlico, under the presidency of Mr. F. S. CLAYTON.

The SECRETARY (Mr. G. H. Gill) having read the notice calling the meeting,

The GOVERNOR observed that he addressed the proprietors on this occasion with feelings of considerable disappointment, for he had hoped to be able to report the result of the audit of the accounts of the Company up to the "appointed day," and also to move a resolution authorizing the Directors to make a final division among the ordinary stockholders. Unfortunately, however, they were unable to do so. The delay which had occurred had been quite unlooked for; and he little thought at their meeting last June that the process of winding up the Company would have been such a lengthy business. The difficulty which had arisen had been almost entirely on the question of the accounts; and the Government Auditor (Mr. Stoneham) had been the stumbling block in the way from the beginning almost to the end. He believed, however, that several of the other Companies had been treated in a similar manner. He proposed to move resolutions confirming payment of the interim dividend in January, and authorizing the Directors to divide the balance in the audited accounts, when completed, among the ordinary stockholders. Considerable time would be saved by the passing of the latter resolution. As he had intimated, the delay had been entirely beyond the Board's control. The accounts up to the "appointed day" would have been ready for audit in August last—ten months ago. Mr. Stoneham was informed of this as far back as July; but he declined to audit the accounts until the Company's stores had been valued by the Water Board's valuer and the figure agreed by the Company. After much correspondence, the Company eventually agreed to accept the figure of the Water Board's valuer. When, however, it appeared that the effect of the valuation was very greatly to increase the amount for stores, the Government Auditor made further technical objections to the accounts under this head. The next step was the valuation by the Water Board; and this was a protracted affair—the person employed to make the valuation also valuing the stores of some of the other Companies. He therefore had not chosen to disclose the result of the valuation of any one Company's stores until his work had been entirely accomplished. After this valuation had been concluded, Mr. Stoneham employed a firm of accountants to examine their accounts afresh; and this took some weeks. The Directors then thought that there was so far an end of the matter; but a fresh audit was necessary, the Water Board thinking that they must send in their accountant to examine the books. This caused further delay. Considerable correspondence took place between their Solicitors and the Secretary and the other side; and ultimately they agreed that the matter in dispute must be referred to arbitration. A request was made to the Lord Chief Justice to name an Arbitrator under the Act of Parliament for the purpose; and Sir Kenelm Digby, K.C., was appointed to decide the matter of difference between the Company and the Government Auditor—he must not say the Water Board. Sir John Hollams had informed them that day that the 10th prox. had been named by the Arbitrator for hearing the case. But for this hitch in the matter of the accounts, the winding up would have been done long ago. However, the whole of the compensation money had been distributed among the proprietors excepting certain sums of unclaimed stock, which would be paid into Court as soon as the audit had been completed and the rate of the final dividend was known. The accounts to June, 1904, had at present been only partially audited; they had not yet been certified by the Government Auditor, nor would they be until the result of the arbitration was known. They would then have to be gone through by the Company's Auditors; but this would only take a few days. When the accounts had been certified, there should be nothing to prevent the immediate payment to the Company of the balance held by the Water Board; and when it was paid, there would be no difficulty—on the passing of the resolution which he would presently move—in declaring a final dividend, and their dealings with the ordinary stockholders would come to an end. Then there would be the payment of the unclaimed stock into Court, and the necessary steps to satisfy the Board of Trade in order to obtain the certificate of that body for the dissolution of the Company, which would afterwards cease to exist. It had been a very trying and anxious time for the Directors and the Secretary; but now that the Arbitrator had named a day for hearing the case, he supposed the end was in view. Meantime, the proprietors of stock had not done badly. The ordinary holders had had a very fair dividend, taking one thing with another, and probably they would have a further 5 per cent.—perhaps more—as the result of the final completion of the accounts. The preference stockholders had also done well; they now had something in excess of the stipulated rate of interest which the Act of Parliament gave them at the time of the issue of the stock. He concluded by moving a resolution confirming the payment of the dividends of Jan. 5 last, as ordered by the Directors—namely, at the rate of 5 per cent. per annum for the 57 days, July 6 to Aug. 31 last, on the 5 per cent. preference stock, at the rate of 4½ per cent. per annum for the same period on the perpetual 4½ per cent. preference stock and the 4½ per cent. (convertible) preference stock, and at the rate of 5 per cent. (equivalent to a dividend at the rate of 12 per cent. per annum for the five months, April 1 to Aug. 31 last on the ordinary stock.

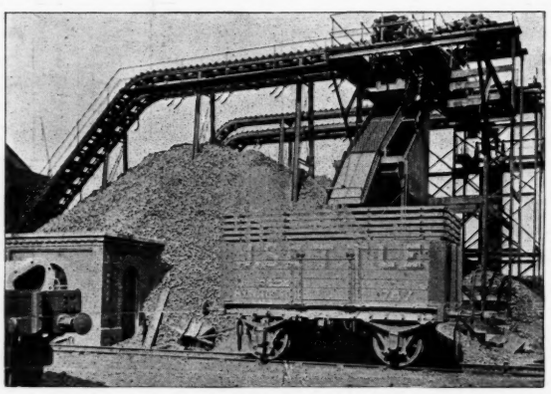
Mr. JACKSON HUNT seconded the motion, and it was carried.

The GOVERNOR afterwards proposed a resolution authorizing the Directors "to provide for and discharge all debts and liabilities of the Company out of the moneys paid or to be paid to the Company by the Metropolitan Water Board under section 40 of the Metropolis Water Act, 1902, and paragraph 2 of the award of the Court of Arbitration of Feb. 22, 1904, and to distribute the balance of such moneys, less expenses, by way of final dividend on the ordinary stock."

A NOVELTY!

HOT COKE CONVEYORS.

Archd. Little's Patent **HOT and COLD COKE CONVEYORS** fitted with



W. T. Holland's Patent **DUST PROOF ROLLERS AND BRACKETS,** The **"KEYSTONE"** Patent, on Conveyors.

On the above Installation Coke is taken from Retorts and put into stock or direct (over screens) into waggons. The Conveyors **AUTOMATICALLY PICK UP FROM STOCK** and discharge into waggons when desired.

SOLE MAKERS:

NEW CONVEYOR CO., LTD., SMETHWICK, BIRMINGHAM.

Mr. HUNT seconded the motion, which was agreed to.

Mr. STONE-WIGG moved a resolution expressing the meeting's appreciation of the ability with which the Directors had conducted the affairs of the Company, "especially during the anxious and trying period since the introduction of the Bill for the Metropolis Water Act, 1902, the opposition to that Bill, the proceedings before the Court of Arbitration, the negotiations with respect to the issue of water stock, and the distribution of the compensation to the shareholders; and this meeting desires that the Directors shall receive as acknowledgment the sum of £6000, and hopes that the amount available under the confirmation scheme may, after providing for the other purposes therein referred to, leave sufficient for that purpose, but should this not prove to be the case that the Directors be authorized to appropriate out of the balance of undivided profits such a sum as may be necessary to make up the £6000." He reminded the proprietors that at the last meeting they passed a resolution for dealing with the whole of the amount set aside under the scheme—£17,807. The Directors were then requested to apply as much of this sum as they thought right among themselves and the staff, leaving any balance which might be available for division among the proprietors. They had distributed among the staff £6000; but it appeared that they did not like to vote themselves the sum mentioned in the resolution before the meeting, and this was why he had been asked to propose it. After the payment of this amount, there would be a margin of £5800, subject to any costs which might have to be paid under the arbitration.

Mr. W. H. TURNER seconded the motion, which was carried unanimously.

The GOVERNOR, in acknowledging the vote, assured the proprietors that the Directors had had "a very hard time of it." Personally, he had been at the office every week since last June, and had taken no holiday. The resolution was another indication of the happy relations which had always prevailed between the proprietors and the Board, of which he had been a member since 1868.

Mr. R. G. CROZIER next moved a resolution placing on record the meeting's high appreciation "of the valuable services rendered to the undertaking during a long course of years by the Secretary (Mr. George Henry Gill), the Assistant Secretary (Mr. H. W. Harrison), the Engineer (Mr. Albert Augustus Gill), the Accountant (Mr. W. H. Turner), and the whole of the staff."

Mr. STONE-WIGG seconded the motion, and, as one of the Auditors stated, that every requirement which had been made by his colleagues and himself had invariably been answered at once with the greatest freedom by the staff,

The resolution was carried unanimously, and was acknowledged by the SECRETARY.

On the motion of the GOVERNOR, seconded by Mr. HUNT, a resolution was also passed thanking Sir John Hollams, the Solicitor of the Company, for the great ability displayed by him in conducting their legal business.

Sir J. HOLLAMS briefly acknowledged the vote.

SHREWSBURY WATER SUPPLY.

The River Scheme.

As briefly mentioned in the "JOURNAL" last week, the Shrewsbury Town Council had before them on the 19th inst. the report of Mr. G. R. Strachan on his scheme for supplying the borough with water from the River Severn. His instructions were that the scheme should be capable of furnishing 35,000 persons with 30 gallons of water per head per day, or an average of 1,050,000 gallons daily. He estimates that the average flow of the Severn at Shrewsbury is 924 million gallons per day, and that the minimum flow is 76 million gallons daily. During heavy floods, the level of the river in the town rises 20 feet; and he believes the maximum flow at such time exceeds 50,000 million gallons per day. There is thus no question as to the sufficiency of the available quantity of water even at the driest times. Touching upon the question of the safety of using supplies drawn from rivers, Mr. Strachan cites London, and thinks "the actual experience of the Metropolitan supplies is reassuring as to the use of river waters when they are properly handled." The precautions to be adopted in the case of such supplies are fourfold: (1) To take the water only when the river is in a good state, and not in flood. (2) To place the intake as far down stream from any source of pollution as is possible. (3) To store the water in a large reservoir before use. (4) To filter the stored water slowly and efficiently. When these conditions are observed, says Mr. Strachan, the water may be passed on to consumers with safety.

Coming to the scheme proposed, Mr. Strachan says there are three convenient sites, at suitable elevations, on which to place the service reservoir—viz., at Sharpstone Hill, at Bayston Hill, and near Lythwood Hall Farm. The first-named site is the one he recommends. The reservoir would have a capacity of 1½ million gallons, a top-water level of 345 feet, and a draw-off level of 337 feet above Ordnance datum, and it would be covered. The principal distribution main would be 20 inches in diameter. The pressures obtained by the scheme would be very satisfactory. With regard to the cost of an upland scheme compared with a river supply, Mr. Strachan says: "In my report on the upland supplies, dated Dec. 10, 1903, I put the cost of the Pulverbatch scheme at £148,000. In this report I put the cost of the river supply with the Sharpstone Hill site at £85,000 for works, *plus* £3000 for lands and easements, which make a total of £88,000. These capital sums show a difference of £60,000 in favour of the river supply; and, so far as I am able to determine the matter on estimates, the figures named are strictly comparable and reliable." He reckons that the expenses of operating the river supply will be £1650, *plus* £400 for depreciation, &c., of the engines and pumps; making a total of £2050 per annum, compared with £700 for the upland gravitation scheme, or an excess of £1350 per annum for the river scheme. The short result, therefore, is that the river supply will cost £60,000 less in capital charges, and £1350 per annum more in annual working expenses than

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the upland scheme, so that the river supply is substantially the cheaper of the two.

After considerable discussion, the report of the Water Committee in favour of the scheme was adopted.

WATER SUPPLY OF CAIRO AND ALEXANDRIA.

Last Wednesday's Engineering Supplement to "The Times" contained a despatch from Egypt, which stated that the problem of providing a plentiful and pure supply of water is now, after many years, just beginning to be surmounted in Cairo and Alexandria.

During the recent phenomenally hot weather, the Cairo Company have been pumping two-and-a-half times more water than is stipulated for in their concession. The population is increasing enormously; and the Company's Engineers have had recourse to artesian wells to reinforce the supply. Several wells have been sunk close to the Nile banks, and pumping has already commenced; but the experiment is regarded as tentative. It will continue for two years, by which time the success or failure of these wells will be amply demonstrated. When the red water of the Nile begins to flow down in June, the energies of the Companies have to be devoted to freeing the water of the fine silt with which it is loaded. This process, it is stated, was imperfectly performed until quite recently; and in Cairo the results do not even yet give unqualified satisfaction. At Alexandria, an extensive filtration plant laid in the reservoirs has just been completed; and as far as can be judged from the limited time the arrangement has been in operation, its efficiency is up to expectations.

Workmen's Bonus at Stafford.—The Stafford Town Council have agreed to a recommendation of the Gas and Electricity Committee that, in pursuance of the arrangement as to profit-sharing by the employees, a bonus of £424 (representing 7 per cent. on the wages) be paid to the clerks and workmen of the Gas Department, and that the sum of £44 (representing about 5½ per cent. on the wages) be paid to the officers and workmen in the Electricity Department. The Chairman of the Committee (Alderman Wright) said the bonus had been well earned, and would be an inducement to the men to do their very best. Mr. Bedford was opposed to the payment; contending that the men should be better paid instead, or the money might be expended in providing labour for the out-of-work men in the town, or in giving a little relief to the penny-in-the-slot consumers. Alderman Wright pointed out that the bonus system had been adopted by the Council for some years, and grew out of an attempt to provide a superannuation fund, which fell through owing to legal difficulties. As regarded the slot-meter consumers, though they paid a little more for their gas, they had advantages not given to the ordinary consumers, inasmuch as they had their fittings and meters provided free of charge.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The annual accounts of the Edinburgh and Leith Gas Commissioners are to be issued on Monday. Their contents are unknown as yet, and, of course, I cannot write upon them; but I will endeavour to give a short summary. I hear that they have turned out well—a view which is borne out by the comparative statement for the past ten years, which has been issued by Mr. Herring, and which is given on another page of this issue of the "JOURNAL." It is almost startling to find that the revenue from residuals has risen during the ten years from £20,632 to £54,163; that manufacturing wages and charges, including purification, have gone down from £46,662 to £26,210; and that, although coal is now 1s. per ton dearer than it was ten years ago, the gross profits have risen from £38,803 to £91,735. The advantages derived from the opening of the Granton works are seen in this, that the revenue from residuals has risen since 1902 by £18,383; that manufacturing wages and charges have fallen since then by £34,426; and that the gross profits have risen by £21,047. The comparison is, perhaps, more striking when we take the year which has just closed—being the first year in which the Granton works bore the whole burden of the gas supply—with the preceding year, when part of the supply was provided from the Edinburgh works. It is found that, in the course of one year, manufacturing charges have gone down by £13,584, and that gross profits have risen by £12,263. There is a temptation to say that the one set of these figures is about equal to the other, and that, consequently, the economies are to be found in the working of the machinery in the retort-house and the purifier-house; but a closer scrutiny reveals that the price of gas was 3d. per 1000 cubic feet less—equal, as is pointed out, to £22,917—and it is thus evident that there have been substantial economies in other quarters, and that the whole of the benefits which the consumers are enjoying is not being taken out of the pockets of the working section of the community. The saving of £22,000 odd is equal to more than 2d. in the pound on the rates.

On Monday of last week, Lord Ardwall, in the Court of Session, heard Counsel upon the evidence recently led in the action by Messrs. J. Muir and Son, Limited, against the Edinburgh and Leith Gas Commissioners, relative to the pollution of a well in the pursuers' brewery. Mr. Guthrie, K.C., for the pursuers, claimed that they had established damage to their Stable Well, for which the Gas Commissioners were responsible in law. There were four questions in the case: (1) Had the pursuers established pollution? (2) Had the pollution been caused by the defenders? (3) Had it been to the pursuers' loss? (4) Suppose that to be the case, were the defenders responsible in law for the damage? To the first question there could only be the one answer, as pollution was admitted. He argued that the pollution had been caused by the defenders, and had been to the pursuers' loss; and that, in law, according to decided cases, the defenders were responsible.

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W. H. PEARSON, Junr., Deputy-Chairman.
J. T. WESTCOTT, Manager.
L. L. MERRIFIELD, M.Inst.M.E., Engineer.

London Offices: 19, ABINGDON STREET, WESTMINSTER, S.W.
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CARBURETTED WATER-GAS ENGINEERS.

The above Company have erected since 1893, or are now erecting, their Universal Type of Carburetted Water-Gas Plant at the following Gas-Works:—

	Cub. Ft. Daily.		Cub. Ft. Daily.		Cub. Ft. Daily.
BLACKBURN.	1,250,000	ST. CATHERINES (Remodelled) .	250,000	TONBRIDGE	300,000
WINDSOR ST. WORKS, BIRMINGHAM	2,000,000	KINGSTON, PA.	125,000	STRETFORD	500,000
SALTLEY WORKS, BIRMINGHAM	2,000,000	PETERBOROUGH, ONT. . . .	250,000	OLDBURY	300,000
COLCHESTER	300,000	WILKESBARRE, PA.	750,000	TODMORDEN	500,000
BIRKENHEAD	2,250,000	ST. CATHERINES (2nd Cont.) .	250,000	SALTLEY, BIRMINGHAM (Third Contract)	2,000,000
SWINDON (New Swindon Gas Co.)	120,000	BUFFALO, N.Y.	2,000,000	YORK (Second Contract) . .	750,000
SALTLEY, BIRMINGHAM (Second Contract)	2,000,000	WINNIPEG, MAN.	500,000	ROCHESTER (Second Contract) .	500,000
WINDSOR ST., BIRMINGHAM (Second Contract) . .	2,000,000	COLCHESTER (Second Contract)	300,000	NEWPORT (MON.)	250,000
HALIFAX	1,000,000	YORK	750,000	TOKIO, JAPAN	1,000,000
TORONTO	250,000	ROCHESTER	500,000	PERNAMBUCO (Brazil) . .	125,000
OTTAWA	250,000	KINGSTON, ONT.	300,000	MALTON	150,000
LINDSAY (Remodelled) . .	125,000	CRYSTAL PALACE DISTRICT .	2,000,000	DULUTH, MINN. (2nd Cont.)	300,000
MONTREAL	500,000	DULUTH, MINN.	300,000	BROCKVILLE (ONT.) . . .	250,000
TORONTO (Second Contract Remodelled)	2,000,000	CATERHAM	150,000	SMETHWICK	500,000
BELLEVILLE	250,000	LEICESTER	2,000,000	GRAVESEND	300,000
OTTAWA (Second Contract). .	250,000	ENSCHEDE (HOLLAND) . .	150,000	NEWPORT MON. (Second Contract)	250,000
BRANTFORD (Remodelled) . .	200,000	BUENOS AYRES (RIVER PLATE CO.)	700,000	TORONTO (Third Contract) . .	750,000
		BURNLEY	1,500,000	TORONTO (Fourth Contract) .	1,000,000
		KINGSTON-ON-THAMES . .	1,750,000	MONTREAL, ONT. (2nd Cont. .	1,800,000
		ACCRINGTON.	500,000	HAMILTON, ONT.	400,000

LEEDS, 1,800,000 C. Ft. LEICESTER (2nd Cont.), 1,000,000 C. Ft. NEWCASTLE-ON-TYNE, 1,800,000 C. Ft.

AND IN ADDITION, 7,900,000 CUBIC FEET DAILY; also Coal-Gas Plants at NELSON, B.C., CHATHAM, BERLIN, NAPANEE, OWEN SOUND, CALGARY, and WINNIPEG.

The pursuers had attempted to make out that the pollution happened in a particular way, and that the defenders failed, in the course of a certain operation, to take due and reasonable precaution to prevent pollution. But, he contended, it would be sufficient for him, on the authority of the cases, if he read them aright, to have proved that material of a noxious nature was produced on the defenders' ground, and was allowed by them to go on to the pursuers' ground, with the result of damage. If the pursuers were to be obliged to provide another supply of water, the cost of a new well would be £7218; of pumping the Stable Well for twenty years, in order to prevent the adjoining well from being polluted, £2080; and the purchase of town water for three years, until the new well would be ready, £537—roughly, £10,000—which would be the measure of the damage sustained by the pursuers. Mr. T. Shaw, K.C., for the defenders, asked absolvitor, upon the simple ground that the pursuers had put forward a specific case, and had failed to prove it. He asked his Lordship to note that there was now no case presented under the Act of 1847. It was, to all intents and purposes, an ordinary action of damages. Lord Ardwall said he would take some time to consider his decision. Upon the facts he would probably not have much difficulty; but as the case would likely go further, he would look into the law.

The Corporation of Dundee are always the first of the large municipalities in Scotland to submit their gas accounts for the year; this being due to the fact that their financial year ends on April 30—a full fortnight before most of the other gas undertakings in the country. This important piece of public business was got through on Wednesday of this week, as will be seen from a report of the proceedings in another column. It cannot be said that the proceedings leave matters in a very clear light to those who have not access to the accounts. The statement is essentially a financial one, and would be much improved if, along with it, the Convener of the Gas Committee were to give some account of the working for the year. This, of course, does not naturally fall to Treasurer Ritchie, who is the spokesman for the department. The criticisms were confined to the two subjects of the free fixing of stoves and the purchase of coal. Mr. Brownlee was, as usual, the dissatisfied one. As to the stoves, there was the double objection that the proposal had not been sufficiently considered in Committee, and that it was an unreasonable scheme. With the first we have little concern—it being a domestic detail. The other objection raises the whole question of the supply of gas-stoves. We may take it for granted that the scheme was not brought forward by Mr. Yuill without sufficient consideration, and that he is quite able, by the aid of his knowledge of what has been accomplished in other towns, to give convincing reasons for his proposals. These, as has been already stated, are that gas-cookers, up to a net value of £5, are to be supplied and fixed free of charge; above that price, a rent of 10 per cent. on the net cost over and above this value to be charged. Users of stoves are to be required to sign an agreement that they will: (1) Keep the stove in use for twelve months after fixing, and pay the costs of connections, together with the fixing and removing, in the event of the stove being removed earlier at the request of the consumer; (2) that they will be responsible for all damage which may occur to the stoves, other than ordinary wear and tear; and (3) guarantee a consumption of gas of from 12,000 to 20,000 cubic feet per annum, according to the size of the stove. The Council, by an overwhelming majority, approved of the proposals of Mr. Yuill; and well they might, when they took into account what was said by Mr. High, to the effect that during 2½ years he had reduced their capital charges by £30,000, rebuilt the retort-house out of revenue at a cost of £10,000, and reduced the price of gas from 3s. 6d. to 2s. 8d. (or no less than 10d.) per 1000 cubic feet.

At a meeting of the Dundee Gas Committee on Tuesday, Mr. Speed referred to the great success which had attended the system of lighting the central and main thoroughfares of the city with incandescent gas-lamps, and urged that an extension of this means of lighting should be made. Mr. Stevenson, the Convener, stated that the Gas Department were fully alive to the importance of the improvement Mr. Speed desired. He stated that arrangements had been made for the carrying out of the work, and that it was hoped that before the end of the year every street and lane in the city would be illuminated by the incandescent gas-light. The same meeting considered the Board of Trade regulations relative to the employment of locomotives in industrial establishments. Mr. A. Yuill, the Engineer and Manager, reported that if the regulations were insisted in, in so far as regarded the Dundee Gas-Works, serious structural alterations would be necessary, and there would be interference with the work of the establishment. The Committee gave instructions to the Clerk to lodge objections to the regulations, and to ask that inquiry should be made.

The profit of the Muirkirk Gas Company for the past year amounted to £197. A dividend at the rate of 7½ per cent. has been paid, and the price of gas has been reduced from 4s. 7d. to 4s. 2d. per 1000 cubic feet. The Edzell Gaslight Company have paid a dividend at the rate of 2½ per cent., and have reduced the price of gas from 7s. 6d. to 7s. per 1000 cubic feet to ordinary consumers, and from 6s. 6d. to 5s. 6d. for gas consumed in stoves. The Elie and Earlesferry Gas Company had a profit of £363. They have paid a dividend at the rate of 6 per cent., and have carried forward £210. The price of gas is being reduced from 5s. 5d. to 5s. per 1000 cubic feet for ordinary consumption, and to 4s. 7d. for cooking and power purposes. The Directors of the Bothwell and Uddingston Gas Company, Limited, report that the net profit for the year has been £2489. They propose to pay the usual dividend of 10 per cent., and to carry forward £785. During the year the quantity of gas sold amounted to 48,559,000 cubic feet, from which there was realized £7095; and, beyond this, £4449 was received from the residual products.

The quantity of gas manufactured in the Dunfermline Corporation Gas-Works during the year ending May 15 amounted to 107,812,500 cubic feet—an increase of 3,130,400 cubic feet upon the year preceding. The quantity accounted for was 102,135,000 cubic feet—an increase of 2,930,100 cubic feet.

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CURRENT SALES OF GAS PRODUCTS.

Week ending June 24.

There has been a big batch of rumours as to dealings in London pitch on the Continent during last week, one-half of which will probably prove to be incorrect. These rumours have, however, had a very sensible effect upon views of buyers, who now consider 29s. 6d. to 30s. f.o.b. Thames as outside figures. An undoubted fact is that large quantities of pitch have changed hands both for the end of this year and well into next, with the result that sellers are very much firmer in their ideas; and this should be borne in mind. Business in 90 per cent. benzol, and in crystal carbolic acid has been somewhat small, but values in both cases are well maintained at 9d. or a little over for benzol, and at 6d. for 35° and 6¼d. per lb. for 39°-40° crystal carbolic. 60° crude carbolic is a little weaker, if anything, at from 1s. 9½d. to 1s. 10d. Oils maintain their position. Sulphate of ammonia is, if anything, not quite so strong; but in reality makers have little or nothing to offer.

LIVERPOOL, *June* 24.

Sulphate of Ammonia.

The market has been quiet, and prices have barely been maintained; the closing quotations being £12 10s. per ton f.o.b. Hull, £12 12s. 6d. f.o.b. Leith, and £12 15s. per ton f.o.b. Liverpool. For July delivery the same prices are quoted. The Continent being still quite off the market, and, other demand being less urgent than was recently the case, makers have had to make some concession in order to effect sales. The forward position is unchanged; there being still a divergence of at least 5s. per ton between the ideas of makers and those of buyers, and buyers not being at all keen in view of the dull nitrate of soda market in the forward position.

Nitrate of Soda.

This article remains quiet at 10s. 10½d. to 11s. 1½d. per cwt., according to quality, on spot.

LONDON, *June* 24.

Tar Products.

There has been very little business doing during the past week, although there has certainly been rather more inquiry all round. In benzol, London makers appear to be fully sold for prompt delivery, and do not seem at all anxious to offer forward unless at improved prices. In the North, however, business has again been done on rather easier terms for early delivery; while in 50-90 per cent. there are still Continental buyers for July-December shipment. Makers, however, decline to entertain business at anything like the prices mentioned by consumers, and seem inclined to defer contracting forward just at present. There are really no stocks of this article; and as the English aniline makers have lately been purchasing fair quantities, it seems probable that prices will be well maintained for the next two or three months. The position of solvent naphtha and toluol remains unchanged; and there is no business of any importance to report, although there is still a fairly good demand. In creosote, sales have again been made in Yorkshire at 1⅜d., although in some instances 1¼d. has been accepted. In the Lancashire district, makers are still taking rather low prices; but the quality of the oil recently delivered has been very salty indeed. In London, the largest producers are still very firm, and appear certainly inclined to wait rather than reduce their quotations. The smaller distillers are, however, selling at fairly low prices; but the quality of the oil is decidedly inferior to that produced by the larger makers. There has not been very much doing in carbolic acid. Several small parcels have, however, been sold at prices varying from 1s. 9½d. to 1s. 9⅝d. for June-July; but with regard to forward there is really nothing doing, as manufacturers are not at all inclined to sell for July-December, unless at a considerable improvement on existing prices. In crystals, a fairly good business has been done in 39-40 per cent.; and it is reported that several good orders have been secured by the German producers. Pitch is decidedly quiet, and as regards prompt it is difficult to fix prices. Sales have undoubtedly been made on the Continent at prices which will not leave 29s. per ton f.o.b. London; and it is reported that business has been done for September-December, but at slightly lower prices. In the Yorkshire district, the demand is fairly good; and it is reported that business has been arranged for forward delivery at about 30s. for special makes. There is, however, very little business doing for forward delivery; and probably there will not be much change in the position until the end of July or early in August, when some of the large tar contracts will be settled. In Lancashire, there is really no business of importance to report; but there is no doubt that several small parcels could be purchased at reasonable prices for early shipment—makers being anxious to clear out stocks. In South Wales, business is very quiet indeed, and the briquette makers report considerable difficulty in selling for either prompt or forward delivery. There have been one or two inquiries from Belgium over the first six months of next year, but manufacturers do not care to sell so far forward unless at a slight improvement on present prices; while consumers appear to think they should buy at lower prices for forward than for prompt.

The average values during the week were: Tar, 16s. 6d. to 21s. 6d. Pitch, London, 28s. 6d. to 29s.; east coast, 28s. to 28s. 6d.; west coast, 26s. 6d. to 27s. 6d. Benzol, 90 per cent., 9d.; 50-90 per cent., 8½d. Toluol, 8½d. Crude naphtha, 3¼d.; solvent naphtha, 8½d. to 8¾d.; heavy naphtha, 10d. to 10½d. Creosote, London, 1½d. to 1⅝d.; North, 1¼d. to 1⅜d. Heavy oils, 2d. to 2 1/16d. Carbolic acid, 60 per cent., 1s. 9½d. to 1s. 9¾d. Refined naphthalene, £4 to £8 10s.; salts, 12s. 6d. to 14s. Anthracene, "A" quality, 1½d. to 1⅝d.; "B" quality, unsaleable.

Sulphate of Ammonia.

The market has been very quiet during the past week, and as a rule prices have been slightly easier. Beckton still quote £12 15s.; but there is really no business doing. The South Metropolitan Gas

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Company reduced their quotation to £12 17s. 6d. on their own special terms, but without effecting sales. The price in Hull still remains £12 10s. for prompt; but business is reported over the last six months of the year at under this figure. In Leith, £12 12s. 6d. may be taken as the nominal value; but no business of importance appears to have taken place during the past week. The market at Liverpool is quiet; and there is very little doing. The nominal price may be taken as from £12 12s. 6d. to £12 15s.

COAL TRADE REPORTS.

Lancashire Coal Trade.

Except for engine fuel, the demand for coal is of a moderate character. Prices remain steady, at the following rates: House coal, best, 13s. to 14s., secondary 12s. to 13s., common 9s. to 10s., best steam and forge coal 8s. to 9s., engine do. 7s. 6d. to 8s. 6d., best slack 7s. to 8s., medium 6s. to 6s. 9d., common 5s. to 5s. 9d. at the pit mouth. Coal for shipping is quiet, varying, according to quality, from 8s. 6d. to 9s. 6d. delivered at the docks. For coke and cannel there is little inquiry. The Manchester Coal Exchange was practically deserted last week. The Whit week holiday would be rather a gain than otherwise to colliery proprietors. The coal trade is always less in summer than in winter; and the sources of supply are so numerous that in some districts only four, and in others three, days per week is the average time worked by the miners. Wages are as low now as they have been since 1898. They stand at 40 per cent. above the 1888 basis, or 5 per cent. above the minimum fixed by the Conciliation Board, and 20 per cent. below the maximum.

Northern Coal Trade.

The coal trade has been rather irregular for the past few days, as there has shown itself, in anticipation of the great local holidays, a fuller demand for some classes of coal. The inquiry for steams is fair for the season, but without the pressure that is sometimes known; so that occasionally an idle day occurs at collieries. Best Northumbrian steams are steady at about 9s. 6d. per ton f.o.b., second-class steams are 8s. 3d., and steam smalls are firm at from 4s. 9d. to 5s. 6d. The gas coal trade is a little easier; the deliveries on the large contracts being at the lowest point of the year. The exports are fairly good, so that the shipping collieries are working steadily. Durham gas coal varies from 7s. 9d. to 8s. 3d. per ton f.o.b.; but there are one or two classes that are quoted 3d. to 6d. higher. Little is being done in the way of contracts at present; but those for one or two south-country towns are now in course of negotiation, and will probably be closed at something like current quotations, or perhaps very slightly less. Coke is firm; and gas-coke is quoted at much the same prices as last given—from 12s. to 12s. 9d. per ton f.o.b. in the Tyne for good quality.

Scotch Coal Trade.

Trade continues to drag, although there is a better demand for shipping. The Baltic trade is now in full swing, which makes a great difference to the Scotch coalowner. Prices have not changed, but are quoted as follows: Main 7s. 3d. to 7s. 6d. per ton f.o.b. Glasgow, ell 8s. to 9s., and splint 8s. 3d. to 8s. 6d. The shipments for the week amounted to 257,553 tons—an increase of 22,470 tons upon the previous week, and of 13,775 tons upon the corresponding week of last year. For the year to date, the total shipments have been 5,395,980 tons—an increase of 372,821 tons upon the same period of 1904.

Price of Coke at Birmingham.—Some anonymous correspondence has been appearing in the Birmingham Press with regard to the price charged by the Gas Department for coke. In reply to a letter calling attention to the fact that coke is being charged in the Manchester district at 10s. 6d. per ton, another writer says that in Manchester or almost any neighbouring town it can be bought at much less than this figure to go away by rail. A gentleman signing himself "Overcharged," says that when he first began to use coke seven or eight years ago, the price for small coke, delivered into his premises in bags, was 13s. 6d. per ton, less 5 per cent. discount for cash paid with the gas account; whereas now, with coal at about the same price as at that time, the charge is 18s. per ton net.

A Big Deficiency at Morecambe.—In presenting the Gas Committee's minutes to the Morecambe Town Council, Mr. Barnsbee had to regret that he was not able to give a very encouraging account of the year's working of the Gas Department, on which there was a deficiency of £1697. The chief reason of this, he said, was a lessened consumption. They had lost £341 by this means, they had not received as much in rents for meters and cookers as last year by £35, and residuals had decreased £290; these three items alone totalling up to £660. The expenditure amounted to a little more than the previous year; but in this a new boiler was included. He hoped matters had taken a turn, and that they would be able to show a better balance-sheet as the result of this year's working.

Opening of New Show-Rooms at Shanklin.—New and excellently arranged offices and show-rooms were opened last week by the Shanklin Gas Company, who have celebrated the event by the holding of an exhibition of stoves, with lectures by Mrs. Collins. The formal opening ceremony was performed by Mrs. White Popham, the Lady of the Manor, in the presence of a large gathering, which included several members of the gas profession. Mr. Francis Cooper, the Chairman, gave a brief history of the undertaking. Both the exhibition and lectures were a great success; the spacious Board-room, in which the latter were held, being well filled each afternoon and evening during the week. There are already close upon 600 gas-cookers in use in the town; and there can be no doubt that the go-a-head policy of the Company and their Secretary and Manager (Mr. F. C. Taylor) will lead to this number being substantially increased in the near future.

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Burglary at a Gas-Works.—The Leighton Buzzard Gas-Works were visited by burglars a few nights ago; but fortunately not a very large amount of money was taken. The office of the Manager (Mr. C. F. Ruggles) was ransacked, and a till and cash-box rifled; but no attempt seems to have been made to open the safe.

A Bath-Heater Fatality in Paris.—Through an escape of gas from the bath-heating apparatus, Mr. Sewell, the Solicitor to the British Embassy of Paris, has lost his second daughter, aged eight years. Becoming suspicious that something was wrong, the father and mother proceeded to the room, and found the poor little girl drowned in the bath. The person of whom she was in charge was lying unconscious on the floor, but fortunately she subsequently revived.

Water-Main Burst at Halsall.—On Sunday week, the 18-inch pipe at Halsall—the chief main supplying Southport, Birkdale, and Formby—burst, and serious inconvenience was caused to consumers; there being a shortage of water for some time. The accident was occasioned in a rather unusual manner. It seems that a piece of the cast-iron main had been eaten through by some chemical element which had formed part of the soil surrounding the main, which was laid thirty years ago. A large hole was found in the pipe and a blue patch remained round it.

Continental Union Gas Company.—An extraordinary meeting of this Company was held last Wednesday, at which the following resolution, passed at the meeting on the 6th inst. (*ante*, p. 843), was confirmed, on the motion of the Chairman (Mr. Arthur Lucas), seconded by Mr. Frederick Tendron: "That the regulations contained in the printed document submitted to the meeting, and for the purpose of identification subscribed by the Chairman thereof, be and the same are hereby approved, and that such regulations be, and they are hereby, adopted as the regulations of the Company, to the exclusion of all the existing regulations thereof."

Mishap at the Cork Water-Works.—Serious inconvenience has been caused at Cork by a breakdown of one of the engines at the water-works, by which the steam power was reduced practically to nothing. To add to the gravity of the situation, the reservoirs were almost empty; and as typhoid fever is prevalent in the county, a shortage of water might have disastrous consequences. It is said that the county supply was almost entirely dependent on the machinery that has broken down, as the turbines now in the works are ineffective when the water is so low in the river as is the case at present. Fortunately a heavy fall of rain, which replenished the reservoirs, occurred in time to avert a water famine in the city.

Cheaper Gas at Bingley.—The profit on the past year's working at Bingley amounted to £1830, of which £1643 has been added to the reserve fund, making it £5055. As the fund has now reached the sum which the Gas Committee some years ago fixed upon before a change could be made in the price of gas, they decided to recommend a reduction of 3d. per 1000 cubic feet to consumers in the District Council area, and 2d. to those outside. On going into the figures, however, it was ascertained that it would be possible to make the reduction 4d. in the Council's area, and still leave a surplus of nearly £500; and the Council have therefore made the concession 4d. and 2d. in the two areas respectively. The sales of gas—nearly 97 million cubic feet—showed a small decrease on the previous year.

A River's Pollution Question.—The Launceston Town Council yesterday week again had under consideration the question of permitting the Gas Company to connect their sulphate of ammonia works with the public sewers. The Conservators of the River Tamar had written to the Board of Agriculture and Fisheries pointing out that it was undesirable in the interests of the fisheries that the effluent from the works should not be open to inspection as at present. The Surveyor thought the difficulty would be overcome if the effluent passed into a tank; a small pipe being provided for the overflow. The effluent could then be tested before it passed into the sewer. Mr. J. Kittow thought it was for the Gas Company to prove that there was no danger in the scheme, and moved that the Council take no further action in the matter. This was agreed to.

Alleged Nuisance from Gas-Works in Kensington.—Dr. T. Orme Dudfield, the Medical Officer of Health for Kensington, in his annual report just circulated, says that complaints were occasionally received during the past year of nuisance from the gas-works at Kensal Green. "There can," he adds, "be no doubt as to the genuineness of the complaints, which receive confirmation from Willesden; the inhabitants of that district suffering when Kensington people have no ground for complaint, and *vice versâ*—the incident of nuisance varying with change in the direction of the wind. That the cause of the nuisance is more or less under control, is proved by the intermittency of the complaints, and as the smells are at times not perceptible to any noxious degree in the vicinity of the works. No proceedings, whether by an indictment or for an injunction, have hitherto been taken."

A Water Shortage in South London.—Some excellent "copy" was furnished last week for the daily papers, by a temporary cutting off of the water supply of Balham, Tooting, and Streatham. On Tuesday, without any warning, the mains ceased to give their accustomed abundance of water; and when the residents had emptied their cisterns, they had to wait as patiently as they could for their replenishment—which took place on the following day. Needless to say, a considerable amount of inconvenience was caused, even in the short period during which the "cut-off" lasted. The explanation of the occurrence furnished by the Metropolitan Water Board was that the failure of the supply was due to the choking of the filter-beds at Surbiton and other Thames-side stations.

The Pinner Gas Company have placed with Messrs. Robert Dempster and Sons, Limited, of Elland, an order for a new retort-bench, including Waddell's patent regenerators.

The Gas Lighting Improvement Company, Limited, have just received an order from the Dumfries Coporation for a Maxim patent carburettor (which is now in course of erection at the gas-works), as well as a contract for a year's supply of benzol for use in same.

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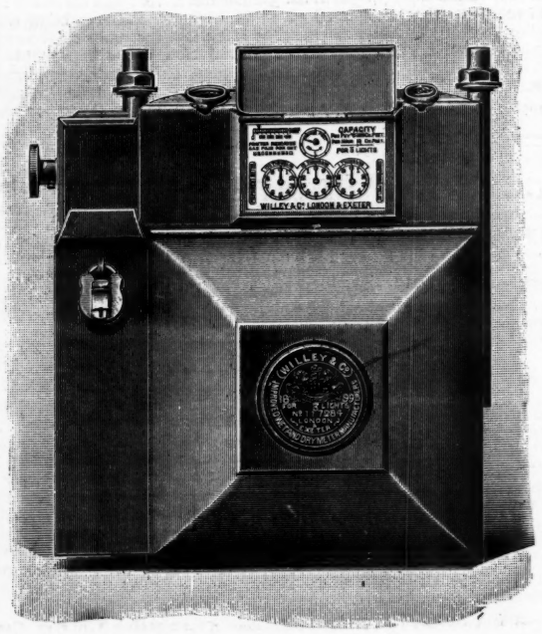

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Wanted, For Sale, and Tender Advertisements, Six Lines and under, 3s.; each additional Line, 6d.

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WANTED, FOR SALE, CONTRACT, &c. ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Situations Vacant.

MANAGER (Australia). No. 4410.
OUTDOOR SUPERINTENDENT. No. 4413.
RENTAL AND LEDGER CLERK. No. 4423.
REPRESENTATIVE (GAS APPARATUS). Sell's Advertising Agency.
FITTER AND BLACKSMITH. Worthing Gas Company.
SUB-FOREMAN. No. 4422.
WORKING MANAGER. Church Stretton Gas Company.

Partner with Capital Wanted. No. 4416.

Situations Wanted.

BOOK-KEEPER, &c. No. 4420.
GAS FITTER. Fitter, Bexhill.
IN GAS OR WATER WORKS (PREMIUM OFFERED). No. 4421.
MANAGER. No. 4412.
SHOW-ROOM MANAGER AND SALESMAN. No. 4407.

Plant, &c., for Sale.

PUMPING MACHINERY. Birmingham Water Department.

Automatic Gas-Meter Arrangement Wanted.
No. 4424.

Gas Works for Disposal. No. 4418.

Plant (Second-Hand) Wanted.

AMMONIA STILL. No. 4417.
BOILER. Sutton Gas-Works.
GAS ENGINE AND EXHAUSTER. No. 4419.

Stocks and Shares.

ALDERSHOT GAS AND WATER COMPANY. July 14.
BRISTOL WATER COMPANY. July 6.
CROYDON GAS COMPANY. July 11.
DORKING GAS COMPANY. July 4.
LOWESTOFT WATER AND GAS COMPANY. July 4.
ROMFORD GAS COMPANY. July 4.
RUGBY GAS COMPANY. June 30.

TENDERS FOR

Coal and Cannel.

BETHESDA GAS DEPARTMENT. Tenders by July 12.
EXMOUTH GAS COMPANY. Tenders by June 30.
ILKESTON GAS DEPARTMENT. Tenders by July 1.

Fire Clay Goods.

PONTYPRIDD GAS DEPARTMENT. Tenders by July 3.

General Stores, Oils, &c.

PONTYPRIDD GAS DEPARTMENT. Tenders by July 3.

Incandescent Goods.

PONTYPRIDD GAS DEPARTMENT. Tenders by July 3.

Iron and Steel and Castings.

PONTYPRIDD GAS DEPARTMENT. Tenders by July 3.

Lime.

PONTYPRIDD GAS DEPARTMENT. Tenders by July 3.

Meters, &c.

PONTYPRIDD GAS DEPARTMENT. Tenders by July 3.

Pipes, &c.

PONTYPRIDD GAS DEPARTMENT. Tenders by July 3.

Tar and Liquor.

ATHERTON GAS COMPANY. Tenders by June 29.
STRETFORD GAS DEPARTMENT. Tenders by July 10.

Valves, Ironmongery, Taps, Lead Piping, Fittings, &c.

PONTYPRIDD GAS DEPARTMENT. Tenders by July 3.

Tar Tank (Railway).

STAFFORD GAS DEPARTMENT. Tenders by July 1.

OXIDE OF IRON.

O'NEILL'S OXIDE
For GAS PURIFICATION.
LARGEST SALE OF ANY OXIDE.

SPENT OXIDE PURCHASED IN ANY DISTRICT.

GAS PURIFICATION & CHEMICAL CO., LD.
JOHN WM. O'NEILL,
Managing Director,
PALMERSTON HOUSE, LONDON, E.C.

WINKELMANN'S

"VOLCANIC" FIRE CEMENT.
Resists 4500° Fahr. Best for GAS-WORKS.
ANDREW STEPHENSON, 182, Palmerston House, Old Broad Street, London, E.C. "Volcanism, London."

J. & J. BRADDOCK (Branch of Meters Limited), Globe Meter Works, OLDHAM, and 54 & 47, Westminster Bridge Road, LONDON, S.E.
WET AND DRY GAS-METERS, PREPAYMENT METERS, STATION METERS, AND GOVERNORS.
REPAIRS RECEIVE PROMPT ATTENTION.
Telephones: 254 Oldham, and 2412 HOP, London.
Telegrams:—
"BRADDOCK, OLDHAM," and "METRIQUE, LONDON."

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SPENT OXIDE PURCHASED IN ANY DISTRICT.

THE First Dutch Bogore Co., Ltd.,
HOLLAND.
General Manager (for England and Wales)—
CHARLES E. FRY, LEAMINGTON.
General Manager (for Scotland)—
J. B. MACDERMOTT, 11, Bothwell St., GLASGOW.

OXIDE OF IRON.
(NATURAL.)

BALE & CHURCH will be pleased to send Quotations and Samples on application.
SPENT OXIDE PURCHASED.
BALE'S FIRE CEMENT for all Retort and Furnace work.
PAINT for Gasholders, Purifiers, &c.
5, CROOKED LANE, LONDON, E.C.

SULPHURIC ACID.

SPECIALLY prepared for the Manufacture of SULPHATE OF AMMONIA.
SPENCER, CHAPMAN, AND MESSEL, LIMITED, 36, Mark Lane, LONDON, E.C. Works: SILVERTOWN.
Telegrams: "HYDROCHLORIC, LONDON."
Telephone: 341, AVENUE.

ROBERT DEMPSTER & SONS, Ltd., Contractor for Complete CARBONIZING PLANTS and every description of GAS APPARATUS and ELEVATING and CONVEYING PLANT, Rose Mount Iron-Works, Elland.

SULPHURIC ACID for Sale, specially suitable for making Sulphate of Ammonia.
Brotherton and Co, Ltd., Chemical Manufacturers. Works: Birmingham, Leeds, and Wakefield.

HYDRATED OXIDE OF IRON.
PREPARED from Pure Iron.
Twice as Rich as Bog Ore.
Gives no Back Pressure.
The Cheapest in the Market.
Can be Exchanged for Spent Oxide.
Read Holliday and Sons, Ltd., Huddersfield.

AMMONIACAL Liquor wanted.
Brotherton and Co., Ltd., Ammonia Distillers. Works: Birmingham, Glasgow, Leeds, Liverpool, and Wakefield.

"VITERNUS" METALLIC PAINT FOR GAS-WORKS PLANT.
JOHN E. WILLIAMS AND CO.,
LOWER MOSS LANE,
MANCHESTER, S.W.
Telegrams: "Enamel." National Telephone 1759.

ATTERTON'S Patent Charging Machine, especially adapted for Small Works up to 50 Millions. Nearly 40 already supplied, and still supplying. Would soon repay for small outlay. Increased make and reduction in cost.
Apply to E. Padfield and Co., 96 & 98, Leadenhall Street, London, E.C.

JOHN RILEY & SONS, Chemical Manu- facturers, Hapton, near Accrington, are MAKERS of Special SULPHURIC ACID, for Sulphate of Ammonia Making. Highest percentage of Sulphate of Ammonia obtained from the use of this Vitriol, which has now been used for upwards of 50 Years. References given to Gas Companies.

GLASS SHADES of every description, for all kinds of Interior **GAS LIGHTING.** Illustrated sheets on application.
JOHN WALSH WALSH,
Soho and Vesta Glass Works, BIRMINGHAM.
Telegrams: "Vesta, Birmingham."
National Telephone: No. 63.
London Show-Room: 4, Holborn Circus, E.C.

SPENT OXIDE.
THE South Metropolitan Gas Company are always open to receive OFFERS of SPENT OXIDE.
Chief Office: 709, Old Kent Road, London, S.E.
Telegrams: "Metrogas, London."

GAS TAR wanted.
Brotherton and Co., Ltd., Tar Distillers. Works: Birmingham, Glasgow, Leeds, Liverpool, and Wakefield.

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BROTHERTON & CO., LIMITED.
Offices: Commercial Buildings, Leeds.
Correspondence invited.

BIGGS, WALL, & CO., 13, Cross Street, Finsbury, E.C. *Telegrams:* "Ragout," London. *Telephone:* 273 Central.
Saturators—See Advt. in last week's issue.
Exhausting Machinery—See Advt. in this week's issue.
Sulphate Plants—See Advt. in next week's issue.

SULPHATE OF AMMONIA SATURATORS and all LEAD and TIMBER WORK in Connection with Sulphate Plants.
We guarantee promptness, with efficiency for Repairs.
Joseph Taylor and Co., Central Plumbing Works, Bolton.
Telegrams: Saturators, Bolton. Telephone 0848.

APPLICANTS for the appointment of Assistant Manager under No. 4404 are THANKED for the trouble taken by them, and are informed that the appointment HAS BEEN MADE.

FOREMAN FITTERSHIP OF THE WATERFORD GAS COMPANY.
APPLICANTS for the above Position are THANKED for their Applications, and are hereby informed that the vacancy HAS NOW BEEN FILLED.

GAS-FITTER seeks situation. Well up in all branches of Gas-Fitting, Slot Installation, Iron and Compo. Good References. Age 26.
Address Gas-Fitter, 46, Station Road, Bexhill-on-Sea.

APPOINTMENT wanted by a Smart Young Man (Age 21), in a Gas or Water Company. Six Years' Experience in the Business. Good at Book-keeping, Shorthand, and Collection of Accounts.
Address No. 4420, care of Mr. King, 11, Bolt Court, Fleet Street, E.C.

SITUATION wanted as Manager of small Works. Well up in Manufacture and Distribution of Gas. Nine Years Experience as Manager. Age 32. Good Testimonials.
Address No. 4412, care of Mr. King, 11, Bolt Court, Fleet Street, E.C.

£20 Premium for introduction lead- ing to suitable Permanent Situation. Age 35. Single. Fifteen Years' Water and Gas Experience. Good Testimonials.
Address No. 4421, care of Mr. King, 11, Bolt Court, Fleet Street, E.C.

WANTED, position as Show-Room Manager and Salesman, with Company opening new Show-Rooms preferred. Ten Years' practical Experience, and thorough knowledge of all latest and up-to-date Gas Appliances, both Cooking, Heating, Lighting, and new methods of pushing Business. Conversant with Accounts and General Routine of Gas Office. Applicant is willing to start at small Salary, with Commission on Increased Business. First-class Testimonials. Age 30. Single.
Address No. 4407, care of Mr. King, 11, Bolt Court, Fleet Street, E.C.

WANTED about July 14, a Working MANAGER for Gas-Works.
State References, Experience, Wages, &c., addressed to Secretary, Church Stretton Gas Company, Church Stretton, Shropshire.

WANTED in the London Office of a Suburban Gas Company, an Experienced RENTAL and LEDGER CLERK.
Apply, by letter, stating full Particulars, to No. 4423, care of Mr. King, 11, Bolt Court, Fleet Street, E.C.

PARTNER with Capital Invited for established Gas Engineering Business, town and country; also for Purchase and Working of Gas-Works. Perfect security.
Address, No. 4416, care of Mr. King, 11, Bolt Court, Fleet Street, E.C.

WANTED, a Departmental Sub-Fore- MAN by a Gas Company. Practical Experience with large Mains and Services, and good character essential.
Apply, by letter, to No. 4422, care of Mr. King, 11, Bolt Court, Fleet Street, E.C.

WANTED by a large firm of Gas Lighting Engineers and Gas Apparatus Makers, a REPRESENTATIVE for the Midland Counties. Must live in the district and have good connection among Gas Companies, Local Authorities, Architects, Ironmongers, &c.,
Address, stating Age, Experience, Salary and Expenses expected, with *copies* of Testimonials, to Box 204, Sell's Advertising Offices, London, E.C.

WANTED, an Energetic, Intelligent Young Man, of good address, to act as the OUTDOOR SUPERINTENDENT of a medium-sized Gas undertaking. He must be able to Interview and Advise Consumers as to the best method of using Gas, and to direct and control a large staff of Gas-Fitters, and Main and Service Layers.
Apply, by letter, stating Age, Experience, and Salary required, to No. 4413, care of Mr. King, 11, Bolt Court, Fleet Street, E.C.

WORTHING GASLIGHT AND COKE COMPANY.
WORKS Fitter and Blacksmith wanted.
A thoroughly handy man, who can make himself generally useful on a Works where Regenerator Furnaces are in use, would find an encouraging position, if suitable.
Apply, by letter, immediately, giving References and stating Wages required, to the undersigned,
W. A. Walker,
Engineer and Manager.
Gas-Works, Worthing,
June 23, 1905.

WANTED, for a Gas-Works in Australia (near Melbourne), making 8 Millions, a capable and well-educated young man as MANAGER.
None but those thoroughly experienced and fully qualified in all branches of Gas Manufacture, particularly the erection and working of Generator Settings, &c., need apply.
Married man and total abstainer preferred.
Applications, stating Age, Experience, and Salary required (House, Fuel, and Gas provided), enclosing *copies* only of recent Testimonials, to be sent to No. 4410, care of Mr. King, 11, Bolt Court, Fleet Street, E.C.

WANTED, a simple, Reliable arrange- ment of AUTOMATIC GAS-METER.
Particulars, in German, to be sent to No. 4424, care of Mr. King, 11, Bolt Court, Fleet Street, E.C.

A SMALL second-hand Horizontal Gas- ENGINE and EXHAUSTER Wanted by a Gas Company. Make, under 4 Millions.
Send full Particulars to No. 4419, care of Mr. King, 11, Bolt Court, Fleet Street, E.C.

WANTED, a Second-Hand Cast-Iron AMMONIA STILL to Treat about 50,000 Gallons per week.
State Price and Particulars to No. 4417, care of Mr. King, 11, Bolt Court, Fleet Street, E.C.

WANTED, a Plain Cylindrical Boiler, about 4 feet diameter, 16 feet long, with Fittings.
J. Wright, 181, Queen Victoria Street, E.C.

WANTED, a good Second-hand Egg or Dish-ended BOILER, 4 feet by 10 feet, or thereabouts, to work at 50 lbs. pressure. State Price delivered at Newhaven, Sussex.
Replies to be sent to Geo. Mead-Robins, Gas-Works, Sutton, Surrey.

FOR SALE—A small Freehold Gas- Works in Hertfordshire. Make about ¾ Million per Annum.
Address No. 4418, care of Mr. King, 11, Bolt Court, Fleet Street, E.C.

TO BE SOLD—Vertical Duplex Gas- Engine by Griffin, 60 I.H.P. Cylinders 11 inches diameter by 13-inch stroke, double Fly Wheels, outside Bearings, Tube Ignition, nearly new.
J. Wright, 181, Queen Victoria Street, E.C.

FOR Sale, very cheap for immediate disposal, TWO PURIFIERS, 10 ft. b 5 ft. by 4 ft. deep, Complete.
STATION METER, 3000 cubic feet per hour, overhauled and proved.
Apply to Samuel While and Son, 60, Queen Victoria Street, London, E.C.

GAS PLANT for Sale—I can always offer NEW and SECOND-HAND GAS APPARATUS, including Retorts and Fittings, Condensers, Exhausters, Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also a few COMPLETE WORKS. Compare Prices and Particulars before ordering elsewhere.
J. F. Blakeley, Gas Engineer, Thornhill, Dewsbury.

NEW Gasholder, 40 ft. diameter by 12 ft. deep, with Steel Standards; also new STEEL TANK to contain same.
Write J. Wright, 181, Queen Victoria Street, London, E.C.

WATER-WORKS PUMPING-ENGINE FOR SALE.
MODERN Compound Surface Con- densing PUMPING-ENGINE and WELL-PUMPS for a depth of 200 feet. Engine Cylinders, 25 in. and 54 in. by 5 ft. Stroke; Pump 24 inches diameter.
STEEL RISING MAIN, with lowering Rods and Screws.
Further Particulars and Order to view to be obtained from the Secretary, Corporation Water Offices, Birmingham.

CORPORATION OF STAFFORD.
THE Gas and Electricity Committee of the above Corporation are prepared to receive alternative TENDERS for the supply of One RAILWAY TAR TANK, of a capacity of 12 or 15 Tons.
Sealed Tenders, endorsed "Tank," and accompanied by Specification and Drawings, to be delivered to the Offices of the undersigned not later than Saturday, the 1st of July.
The Committee do not bind themselves to accept the lowest or any Tender.
(Signed) Hubert Pooley.
Engineer.

GAS COAL.
THE Bethesda Urban District Council are prepared to receive TENDERS for the GAS COAL required at their Gas-Works during the ensuing Year, in such quantities and at such times as may be required (in all about 300 Tons), from the 1st of August, 1905, to the 31st of July, 1906.
Tenders to state price per Ton, and be accompanied by an Analysis of the Coal.
The person whose Tender is accepted will be required to enter into an agreement with the Council for the due performance of his Contract.
The lowest or any Tender not necessarily accepted.
The Tenders to be sent in on or before the 12th day of July, 1905.
D. Griffith Davies,
Clerk and Solicitor.
Bethesda, June 21, 1905.

PONTYPRIDD URBAN DISTRICT COUNCIL.
(Gas Department.)
THE above Council invite Tenders for the supply of the following STORES and MATERIALS, required during the Year ending June 30, 1906—
No. of Contract.
5—Fire Clay Goods, Lime, &c.
6—Iron Tubing, Fittings, &c.
7—Lead and Compo.
8—Iron and Steel.
9—Oils and Drysaltery.
10—Brass Fittings and Sundries.
11—Slot Fittings.
12—Dry Meters.
13—Main Taps and Locks.
14—Steam Valves.
15—Castings.
16—Incandescent Lighting Goods.
17—Ironmongery.
Forms of Tender and any Information required may be obtained from Mr. Edward Jones, Gas Engineer, Gas-Works, Treforest, near Pontypridd.
No Tenders other than those upon the Forms issued will be considered.
Sealed Tenders, endorsed "Tender No. ——," must be received by the undersigned on or before the 3rd of July, 1905.
J. Colenso Jones,
Clerk to the Council.
District Council Offices,
Pontypridd, June 15, 1905

CORPORATION OF ILKESTON.

(GAS DEPARTMENT.)

THE Gas Committee invite Tenders for 10,000 Tons of GAS COAL, NUTS, or CANNEL, to be delivered as required at the Gas-Works Siding (Midland Railway).

Forms of Tender supplied on Application. Such Forms only may be sent in, Sealed and endorsed, to Wright Lissett, Esq., Town Clerk, not later than July 1, 1905.

The Committee do not pledge themselves to accept the lowest or any Tender, and reserve their right to divide the quantity.

F. C. HUMPHRYS,
Engineer and Manager.

Gas-Works, Ilkeston,
June 15, 1905.

EXMOUTH GAS COMPANY.

THE Directors of the Exmouth Gas Company invite TENDERS for the supply of 4500 to 5000 Tons of best GAS COAL (screened or unscreened), to be delivered in such quantities and at such times as may be required from the 1st of August, 1905, to the 31st of July, 1906, and to weigh 20 cwt. to the Ton over the Gas Company's or Dock Company's weighbridge (the said machines are regularly inspected by the Officer under Weight and Measures Act). The Coal to be fresh wrought, dry, and free from Hards, Smudge, Dirt, Shale, and Pyrites.

Tenders to be accompanied by practical working Analysis.

Prices may be quoted c.i.f. or f.o.b. Exmouth Docks (by sailing vessels only), or f.o.r. Exmouth Railway Station (L. & S.W. Railway).

Sealed Tenders, endorsed "Tenders for Coal," to be addressed J. Palmer, Esq., Chairman, and delivered to the undersigned not later than Friday, the 30th day of June, 1905.

The Directors do not bind themselves to accept the lowest or any Tender.

Forms of Tender are not supplied.

JAMES T. FOSTER,
Secretary and Manager.

Gas-Works, Exmouth,
June 6, 1905.

GAS TAR.

THE Urban District Council of Atherton invite TENDERS for the purchase of the TAR produced at their Gas-Works during Twelve Months from the 30th of June inst. Probable quantity, about 400 Tons.

Sealed Tenders to be delivered to the undersigned on or before Thursday, the 29th inst.

D. SCHOFIELD,
Clerk.

THE Stretford Gas Company are pre- pared to receive TENDERS for the surplus GAS TAR and AMMONIACAL LIQUOR produced at their Works (together or separately) for a period of One, Two, or Three Years, commencing July 1, 1905.

The Directors are prepared to make the Contract on the sliding-scale basis or otherwise.

Tenders to be sent in, addressed to the Chairman, endorsed "Tenders for Tar," &c., on or before Monday, July 10, 1905 (Twelve o'clock noon).

Form of Tender may be obtained from the Secretary.

The Directors do not bind themselves to accept the highest or any Tender.

BENJAMIN HAYNES,
Secretary.

Stretford, June 16, 1905.

THE Transfer Books of the Holyhead and North Wales Gas and Water Corporation, Limited, WILL BE CLOSED from the 19th to the 29th day of June, both days inclusive.

THE GASLIGHT AND COKE COMPANY.

NOTICE is Hereby Given, that the TRANSFER BOOKS of this Company, so far as they relate to Capital Stocks WILL BE CLOSED at Four o'clock p.m. on Tuesday, the 4th day of July next, and will be RE-OPENED immediately after the Half-Yearly Ordinary General Meeting of the Company to be held on the 4th day of August next.

By order,
HENRY RAYNER,
Secretary.

Chief Office, Horseferry Road,
Westminster, S.W., June 22, 1905.

In the Matter of the Rotary Meter Syndicate, Limited.

IN LIQUIDATION IN CONSEQUENCE OF SALE TO THE ROTARY METER COMPANY (1905), LIMITED.

NOTICE is Hereby Given, that the Creditors of the above-named Company are required, on or before the 31st day of July, 1905, to send their names and addresses and the particulars of their Debts or Claims, and the names and addresses of their Solicitors (if any), to Squire Edward Worsley, of 1, Mawson Chambers, Deansgate, Manchester, Secretary to the Liquidator of the said Syndicate, and if so required, by notice in writing from the said Liquidator, are, by their Solicitors, to come in and prove their said Debts or Claims at such time and place as shall be specified in such notice, or in default thereof they will be excluded from the benefit of any distribution made before such debts are proved.

Dated this 21st day of June, 1905.

ALFRED GRUNDY, SON, AND CO.,
Solicitors to the above-named Liquidator.
78, King Street, Manchester.

ISSUES BY AUCTION OF GAS AND WATER STOCKS AND SHARES.

MR. ALFRED RICHARDS begs to notify that his ISSUES by AUCTION under PARLIAMENTARY POWERS of STOCKS and SHARES in LONDON, SUBURBAN, and PROVINCIAL GAS and WATER COMPANIES take place PERIODICALLY at the Mart, TOKENHOUSE YARD, E.C.

Terms for Issuing such Capital, and also for including in Gas and Water Stocks and Shares belonging to Private Owners in these Periodical Sales, can be obtained on application at MR. ALFRED RICHARDS' OFFICES, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the
ROMFORD GAS AND COKE COMPANY, LIMITED.

NEW ISSUE OF 1000 £5 "B" SHARES.

MR. ALFRED RICHARDS will Sell the ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, July 4, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the
LOWESTOFT WATER AND GAS COMPANY.

NEW ISSUE OF 400 ADDITIONAL ORDINARY £10 SHARES,

Ranking for a Maximum Dividend of 7 per cent., previous Issues of similar Shares now receiving 5½ per cent.; also

£1000 FOUR PER CENT. PERPETUAL DEBENTURE STOCK.

MR. ALFRED RICHARDS will Sell the ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, July 4, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

DORKING GAS COMPANY.

20 £25 "D" ORDINARY SHARES.

MR. ALFRED RICHARDS will Sell the ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, July 4, at Two o'clock.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

ALDERSHOT GAS AND WATER COMPANY.

ALDERSHOT GAS AND WATER ORDER, 1903.

NOTICE is Hereby Given, that the Directors of this Company have authorized the SALE BY TENDER, of

FIVE THOUSAND POUNDS (£5000)

Nominal Four per Cent. Perpetual Debenture Stock.

Forms of Tender, and other Particulars, can be obtained on application at the Offices of the Company.

Tenders to be received not later than Ten o'clock a.m., July 14, 1905.

By order,
R. W. EDWARDS,
Secretary and General Manager.

General Offices, Victoria Road,
Aldershot, May 26, 1905.

To Trustees and Others.

MESSRS. HOOKER & WEBB have re- ceived instructions to SELL BY AUCTION, at the Mart, Tokenhouse Yard, E.C., on Tuesday, July 11, at Two o'clock precisely, in 164 Lots,

£15,000 FOUR PER CENT. PERPETUAL DEBENTURE STOCK
of the
CROYDON GAS COMPANY.

Particulars and Conditions of Sale may be had of the SECRETARY at the Offices of the Company, Katharine Street, CROYDON; at the MART, E.C.; and of the AUCTIONEERS, 4, High Street, CROYDON. Telephone No. 122 Croydon.

RUGBY GAS COMPANY.

(INCORPORATED BY THE RUGBY GAS ACT, 1882.)

130 SHARES OF £10 EACH

(Additional Capital) or such less number as shall be declared at the time of Sale.

TO BE SOLD BY AUCTION BY

MR. JOHN R. TAIT (of the firm of TAIT, SONS, AND PALLANT), at the Royal George Hotel, in Rugby, on Friday, June 30, 1905, at Four o'clock in the Afternoon precisely, by order of the Company (under the provisions of the Rugby Gas Act, 1882), in Lots of Five Shares each.

The above Shares are part of the authorized additional capital of the Company and bear the standard dividend of 7 per cent. subject, under the sliding-scale, to increase or diminution with the price charged for gas.

The present price of gas admits of an estimated dividend on these Shares of £10½ per cent. per annum.

The dividend on the original capital of the Company for the past three years has been £13 per cent. per annum, and the present price of gas admits of an estimated dividend of £13½ per cent. per annum.

Particulars and Conditions of Sale, now ready, may be obtained at the OFFICES OF THE COMPANY, Railway Terrace, in RUGBY; of the AUCTIONEER, 2, Albert Street, RUGBY; or from

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MESSRS. ALEXANDER, DANIEL, AND CO. will SELL BY AUCTION, at the Bank Auction Mart, Corn Street, Bristol, on Thursday, July 6, 1905, at Three o'clock in the Afternoon,

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The above £15,000 Stock is part of the 7 per cent. Maximum Consolidated Ordinary Stock, amounting to £970,000, created under the powers of the Bristol Water-Works Acts, 1888, 1889, 1895, and 1902.

The Dividend is subject to proportionate diminution whenever the Maximum Dividend to which each class of Ordinary Shares or Ordinary Stock of the Company is entitled shall not be paid in full; but such diminution may be made up in subsequent years.

For further Particulars and Conditions of Sale apply to the AUCTIONEERS, Bank Chambers, Corn Street, BRISTOL; to Messrs. EDWARD GERRISH AND CO., Lloyd's Bank Buildings, Corn Street, BRISTOL; or to

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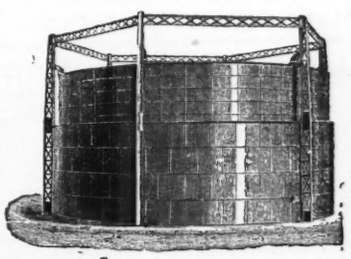
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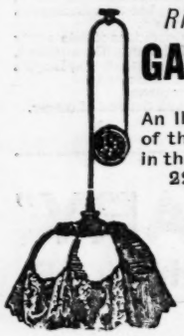

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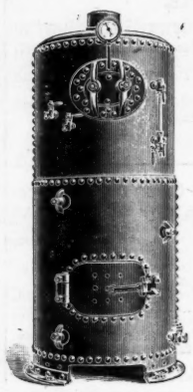

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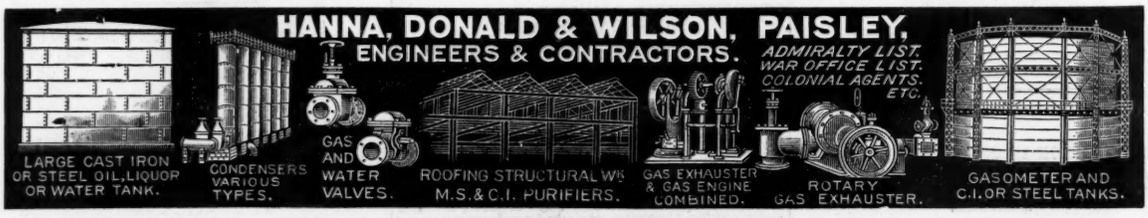
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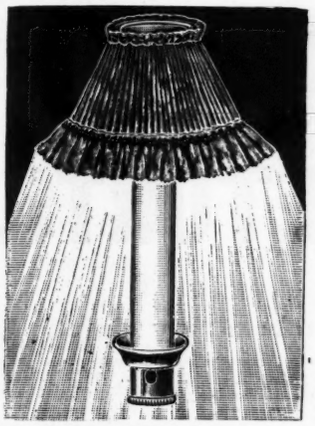

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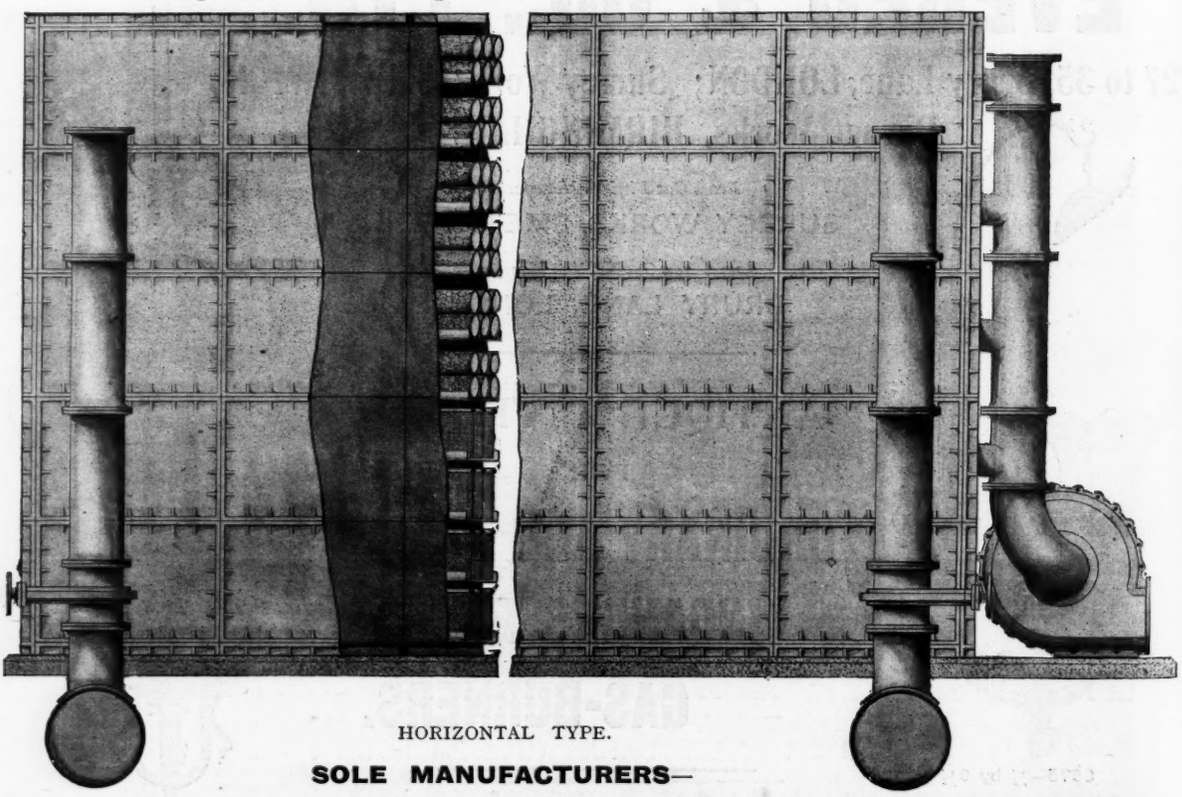

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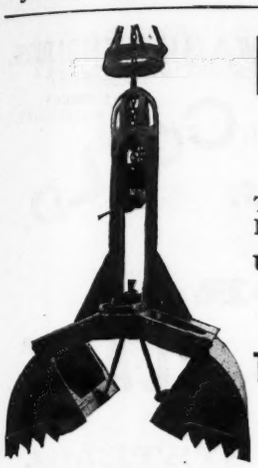

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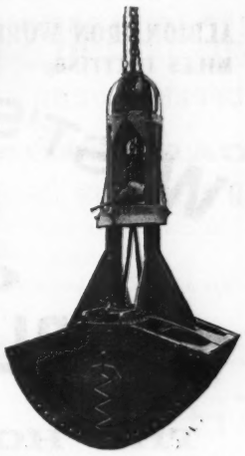

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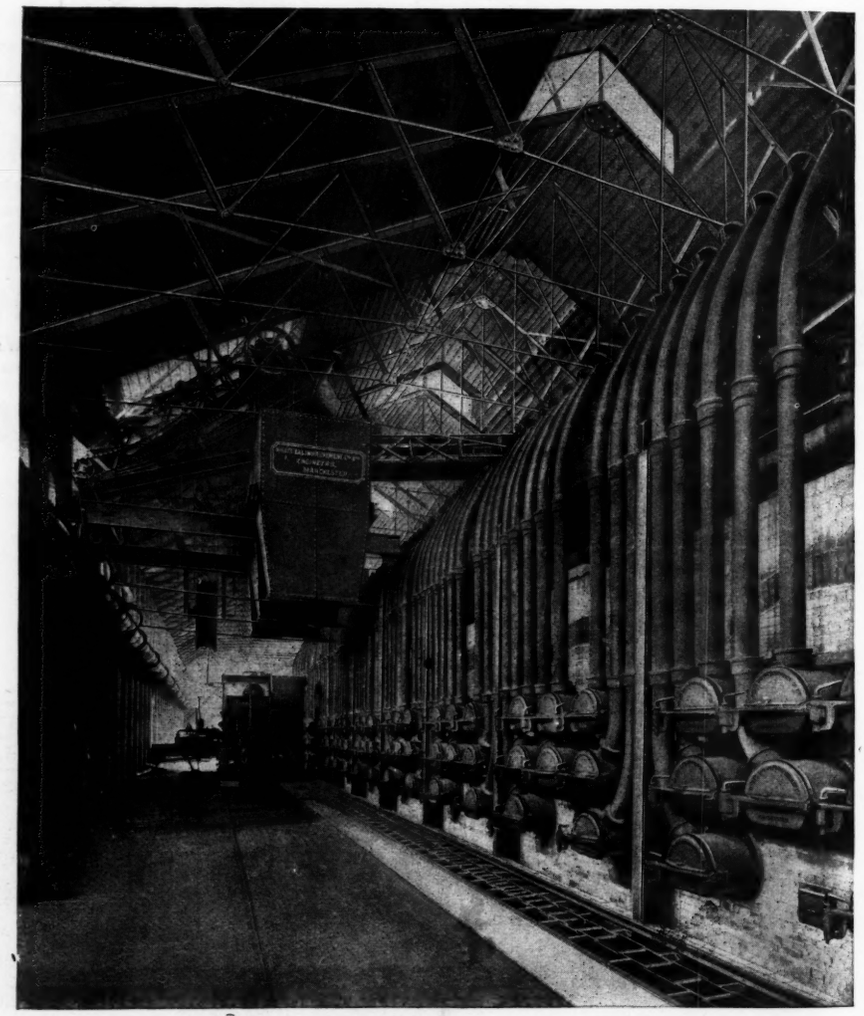

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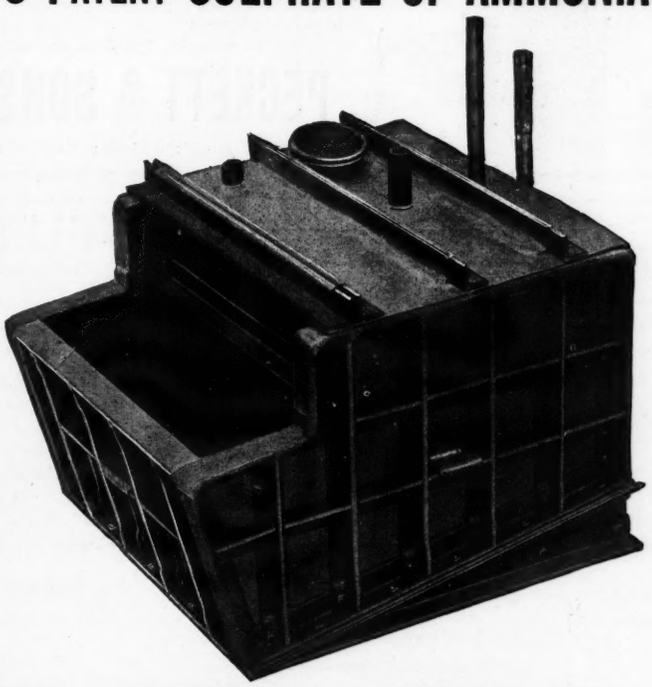

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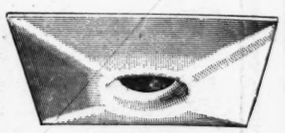

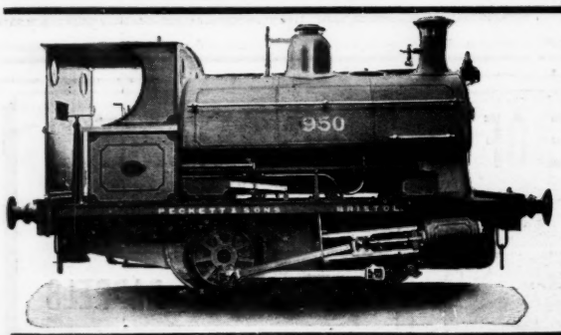

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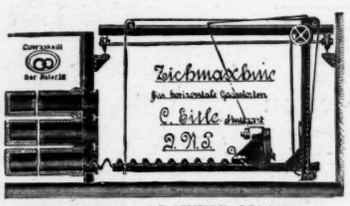

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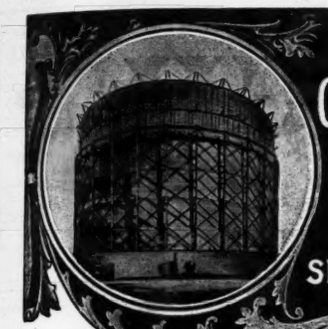

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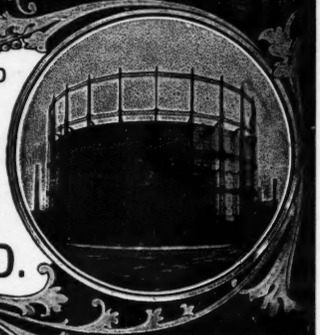

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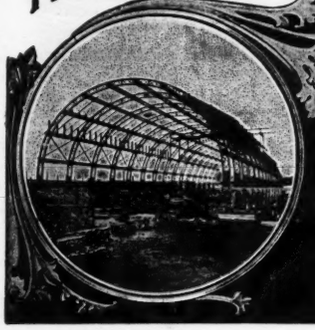

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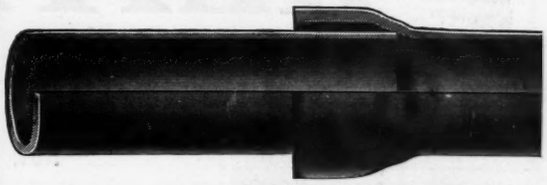

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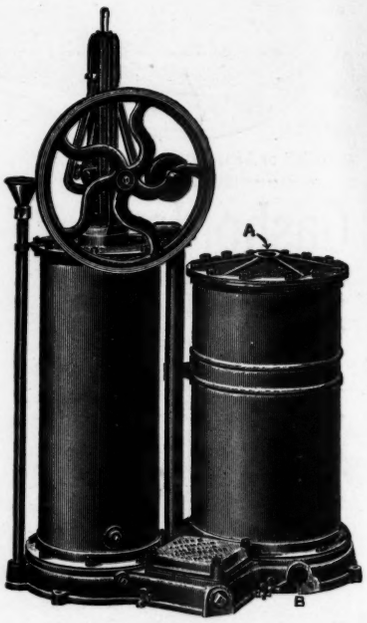

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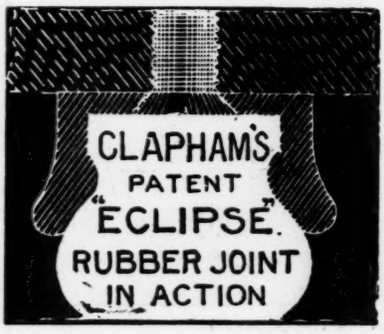

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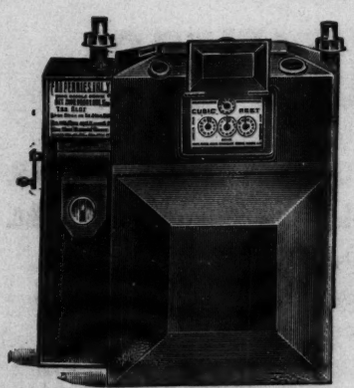
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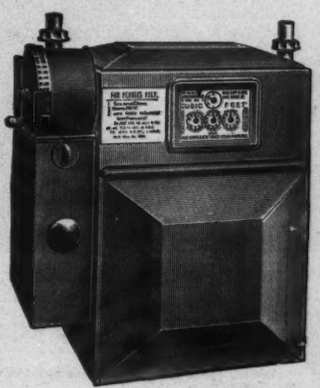
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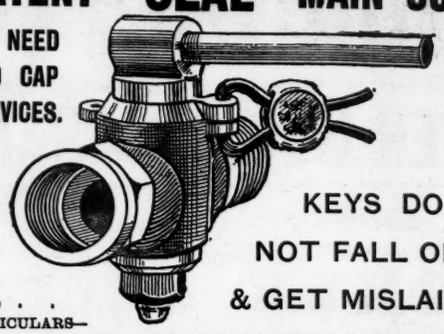

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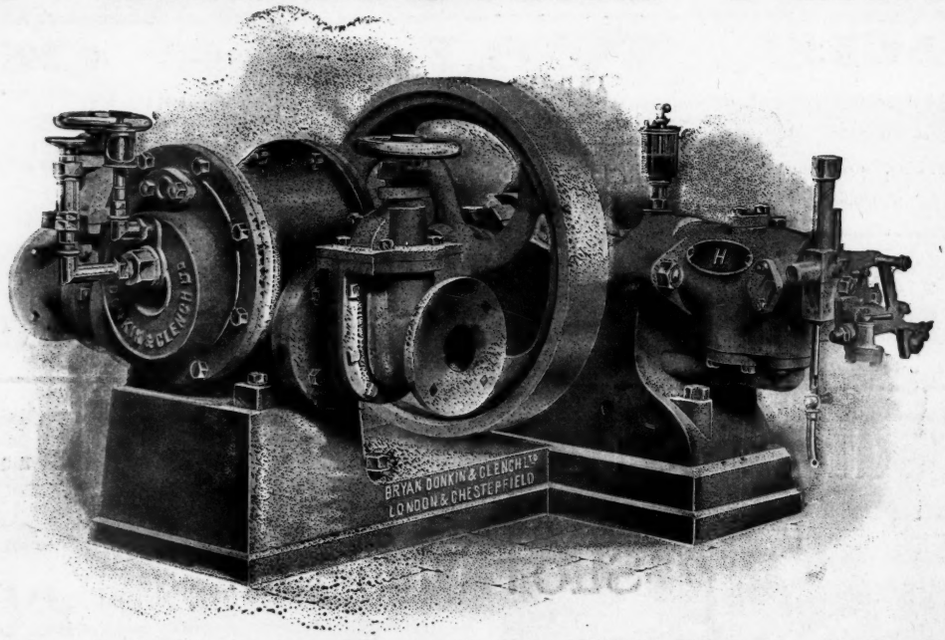

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